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mposium
the Use of
Herbicides in
Forestry

February 21-22, 1978
Crystal City Marriott Hotel
Arlington, Virginia

United States Department of Agriculture
United States Environmental Protection Agency

ADDENDUM TO THE

SYMPOSIUM ON THE USE OF HERBICIDES IN FORESTRY

FEBRUARY 21-22, 1978

CRYSTAL CITY MARRIOTT HOTEL
ARLINGTON, VIRGINIA

U.S. DEPARTMENT OF AGRICULTURE
U.S. ENVIRONMENTAL PROTECTION AGENCY

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ANNOTATED BIBLIOGRAPHY

ON

2,4,5-T AND TCDD[1/]

PREFACE

This is a critically annotated bibliography, not an exhaustive one. It concentrates on TCDD. 2,4,5-T papers are indexed separately. It is important to clearly distinguish between 2,4,5-T and TCDD. At the moment that spray enters the environment, the two go their separate ways.

Please address all questions or corrections regarding this material to: Steve W. Hager, Citizens Aginst Toxic Sprays (CATS), 1385 Bailey Avenue, Eugene, Oregon 97402.

[1/] As submitted, with cursory editing.

1. Allen, J.R., D.A. Barsotti, J.P. Van Miller, L.J. Abrahamson, and J.J. Lalich, 1977a. Morphological changes in monkeys consuming a diet containing a low level of 2,3,7,8-tetrachlorodibenzo-p-dioxin. Fd. Cosmet. Toxicol., in press.

   500 ppt in diet for 9 months - female rhesus monkeys. 1 died 28th week; 1, 36th wk; 3, 44th wk. "profound cellular alterations" "...cellular deterioration in bone marrow and lymphoid tissue becomes widespread." Agrees quite well with Allen and Carstens, 1967. "altered lymphopoiesis could be associated with immune suppression. The possibility of reproductive abnormalities also exists." Difficulties in conception and early abortions (female), "testicular atrophy" (male). Hypertrophy, hyperplasia, metaplasis suggest "carcinogenic action."

2. Allen, J.R. and L.A. Carstens, 1967. Light and electron microscopic observations in Macaca mulatta monkeys fed toxic fat. American Journal of Veterinary Research, 28: 1513-1526.

   Their data was used by Baughman and Meselson, 1973, to show linear relation between mean survival time and reciprocal of dietary dose - survival times up to 445 days!

   Also see Norback and Allen, 1973.

3. Allen, J.R., J.P. Van Miller, and D.H. Norback, 1975. Tissue distribution, excretion and biological effects of (14C) tetrachlorodibenzo-p-dioxin in rats. Fd. Cosmet. Toxicol., 13: 501-505.

   50 ug/kg stomach intubation: 50% died in 25 days, 44% TCDD still in body at 21 days (21 days, 1/2 life), 4.5% in urine, increasing from week 2→3. Most localized in liver! (55% on day one, decreasing).

   "Thymic hypoplasia is a constant feature of TCDD intoxication in most animal species."

   "...only a small zone of the cortical thymus was apparent, yet the spleen and lymph nodes appeared unaffected."

4. Anonymous, 1971. Environment, 13(10): 28-29

   Domestic animal symptoms (referenced by Butler, 1974). Low calving rate from use of Silvex and 2,4,5-T.

   Girl suffered fatigue, headaches, and nausea after being wetted with Silvex.

5. Anonymous, 1975.

   EPA has found unsafe levels of TCDD in half of beef fat samples. Chemical and Engineering News, 53(34): 10.

6. Axelson, O. and L. Sundall, 1974. Herbicide exposure, mortality, and tumor incidents, an experimental study of Swedish railroad workers. Work-Environ-Health, 11: 21-28.

Studied Swedish railway workers who used herbicides. Decent study because of good records kept by government. Amitrole and monuron definitely cause cancer. 2,4-D, 2,4,5-T are uncertain. If just one worker who was exposed to both amitrole and D and T was shifted to the D and T population there would also be significant positive correlation for cancer in the phenoxy group. Emphasizes need for good records for valid epidemiology.

7. Bauer, H., K.H. Schulz, and U. Spiegelberg, 1961. Occupational intoxications in manufacturing chlorophenol compounds. Arch. Gewerbepath. Gewerbehyg, 18: 538-555.

See Poland et al., 1971

8. Baughman, R., 1974. Tetrachloro-dibenzo-p-dioxin in the environment: High reduction mass spectrometry at the picogram level. Ph.D. Dissertation, Harvard University.

See Baughman and Meselson, 1973a.

9. Baughman R., and M. Meselson, 1973a. An analytical method for detecting TCDD (dioxin): levels of TCDD in samples from Vietnam. Environmental Health Perspectives, 5: 27-35.

TCDD detection @ ~ 1 ppt. 18-310 ppt in 1970 S. in 197
Vietnam fish and crustacean samples. Summary table of biological effects to that time (1973).

10. Baughman, R., and M. Meselson, 1973b. An improved analysis for tetrachlorodibenzo-p-dioxins. pp. 92-104. In: Blair, E.H. (ed.) Chlorodioxins, Origin and Fate. American Chemical Society, Advances in Chemistry Series, No. 120. 141 pp.

This is the earlier paper: see 1973a.

11. Baughman, R., and M. Meselson, undated. Additional data concerning chloro-dioxins present in fish from South Vietnam. (mimeographed, 2 p., 2 tables.) Harvard U. Cambridge, 02138.

"In view of these results we feel that it is highly unlikely that the TCDD observed in these fish samples originated from pentachlorophenol."

12. Beatty, P.W., K.J. Lembach, M.A. Holscher, and R.A. Neal, 1975. Effects of 2,3,5,8-tetrachlorodibenzo-p-dioxin (TCDD) on mammalian cells in tissue cultures. Toxicol. Appl. Pharmac., 31: 309-312.

10-6 in culture medium. Problem with labelled TCDD binding to flasks in which tests were run. "...the lack of any effect of TCDD at the organizational level of the

cultured cell used in these experiments may have been due to the unique environmental conditions of cell culture, the possible specificity of TCDD action upon cell types other than those studied here, or the action of TCDD upon a physiological control mechanism requiring a level of organization greater than that of the single cell." (p.312)

13. Beck, J.P., W.H. Macklin II, and E.L. Arnold, 1976. Degradation of chlorophenoxyalkanoic acid herbicides by purified cultures of soil micro-organisms (Abs.) Abstracts of the 1976 Meeting of the Weed Science Society of America, Feb. 3-5, 1976.
    2,4-D 90% in 18 days, vs. 2,4,5-T 50% in 18 days. Soil collected from treated land!

14. Bionetics Research. unpublished. Evaluation of the carcinogenic, teratogenic and mutagenic activity of selected pesticides and industrial chemicals. Vol III (Evaluation of the teratogenic activity of selected pesticides and industrial chemicals in mice and rats.) 7300 Pearl St., Bethesda, MD 20014 under contracts PH43-64-57 and PH43-67735 with NCI.
    Teratogenicity:
    "100 mg/kg (high)/oral ("relative inactivity" of route)
    "probably dangerous": 2,4,5-T (p. 11)
    "potentially dangerous, but needing further study": 2,4-D iso-octylester, piperonyl butoxide, 2,4-dichlorophenol, et al. (p. 11)
    "fetotoxic, but probably not teratogenic": 2,4-D butyl ester, Sevin, Atrazine, et al.
    other esters of 2,4-D showed scattered anomalies.

15. Bjerke, E.L., J.L. Herman, P.W. Miller, and J.H. Wetters, 1972. Residue study of phenoxy herbicides in milk and cream. Agricultural and Food Chemistry, 20(5): 963-967.
    2,4,5-T residues in milk ranged from approximately .005 - 0.10% of the concentration in the diet. 2,4-D residues up to 0.01% of the concentration in the diet. Silvex, up to .01% of the dietary concentration. Industry study.

16. Blair, E.H. (ed), 1973. Chlorodioxins-origin and fate. American Chemical Society, Advances in Chemistry Series, No. 120. 141 pp.
    Note: This symposium was held in 1971, so most of this data is older than the publishing data indicates. Individual papers from this volume are referenced here.

17. Bleiberg, J., M. Wallen, R. Brodkin and J.L. Appelbaum, 1964. Industrially acquired porphyria. Arch. Derm., 89: 793-797.
    See Poland et al., 1971

18. Bovey, R.W., 1976. (USDA) The phenoxy herbicides revisited (Abs). In: Abstracts of the 1976 Meeting of the Weed Science Society of America, Feb. 3-5, 1976.

"Movement of phenoxy herbicides can occur in surface runoff water if heavy rainfall occurs soon after treatment."

19. Bowes, G.W., B.R. Simoneit, A.L. Burlingame, B.W. DeLappe, and R.W. Risebrough, 1973. The search for chlorinated dibenzofurans and chlorinated dibenzo-dioxins in wildlife populations showing elevated levels of embryonic death. Environmental Health Perspectives, Experimental Issue No. 5, 191-198.

No dioxin residues found in herring gull eggs; or sea lion liver, blubber; but no indication of analytical sensitivity for TCDD.

20. Butler, W.A., 1974. Prehearing brief. In re: 2,4,5-Trichlorophenoxyacetic Acid (2,4,5-T). I.F. and R. No. 295.

Environmental Protection Agency, before the hearing examiner. Good synthesis and bibliography.

21. Buu-Hoi, N.P., D. Hien, G. Saint-Ruf, and J. Servoin-Sidoine, 1971a. Comptes Rendus des Seances de l'Academie des Sciences, Paris, Serie D, 272: 1447-1450.

Proprietes canceromimetiques de la tetrachloro-2,3,7,8 dibenzo-p-dioxine ("dioxine").

SWH trans: ...these results show that (TCDD) is capable, even at very low doses, of profoundly disturbing the enzymatic system of organisms, similar to the abilities of the carcinogens benzo (α)-pyrene and p-dimethylamino-azobenzene. These disturbances are probably due in part to the extraordinarily slow toxicity of (TCDD).

22. Buu-Hoi, N.P., G. Saint-Ruf, P. Rigot, and M. Mangane, 1971b. Preparation, proprietes et identification de la "dioxine" (tetrachloro-2,3,7,8-dibenzo-p-dioxine) dans les pyrolysats de defoliants a base d'acide trichloro-2,4,5-phenoxyacetic et de ses esters et des vegetaux contamines. C.R. Acad. Sci., Paris, Serie D, 273: 708-711.

Langer, Brady and Briggs, 1973, point out that the authors have misidentified the mass spectrum of TCDD (p. 710).

Also see Baughman and Meselson, 1973a, for correct spectrum. Whether this error affects the results of the author's earlier and later papers is not clear.

23. Buu-Hoi, N.P., Pham-Hue Chank, G. Sesque, M.C. Azum-Gelade, and G. Saint-Ruf, 1972a. Enzymatic functions as targets of the toxicity of "dioxin" (2,3,7,8-tetrachloro-dibenzo-p-dioxin).

Naturwissenschaften, 59: 173-174.

Showed:

1) "deep pertuburations in several enzymatic systems in rats, and

2) profound disturbance in homeostatis indicating... that the liver is one of the main targets of "dioxin" intoxication."

24. Buu-Hoi, N.P., Pham-Huu Chanh, G. Sesque, M.C. Azum-Gelade, and G. Saint-Ruf, 1972b. Organs as targets of "dioxin" (2,3,7,8-tetrachlorodibenzo-p-dioxin) intoxication. Naturwissenschaften, 59(4): 174-175.

Skin injected dose of 10 mg/kg. Saw lesions of the liver, involution of the thymus, edema of the heart.

25. Carter, C.C., R.C. Kimbrough, J.A. Liddle, R.E. Cline, M.M. Zack, W.F. Barthel, R.E. Koehler, and P.E. Phillips, 1975. Tetrachlorodibenzodioxin: an accidental poisoning episode in horse arenas. Science 188, 738-740.

See Commoner and Scott, 1976a.

26. C.A.S.T., 1975. The phenoxy herbicides. Council for Agricultural Science and Technology, Report No. 39, February, 1975.

The definitive industry whitewash job.

Completely unreferenced.

27. Collins, T.F.X. and C.H. Williams, 1971. Teratogenic studies with 2,4,5-T and 2,4-D in the hamster. Bull. Environ. Comtam. Toxicol., 6(6): 559-567.

100 mg/kg 2,4,5-T: abnormalities/live litter significantly increased both with and without dioxin.

40 mg/kg and 80 mg/kg 2,4,5-T without dioxin increased embryonic mortality and liveborn with hemorrhages. Fetal viability per litter significantly decreased in dose-related manner.

60 mg/kg 2,4-D caused fetal anomalies.

"Hemorrhagic gastrointestinal tracts in the hamster fetuses were a prominent effect of 2,4,5-T" ...dioxin "increased the level of hemorrhages in the liveborn."

Terata were produced occasionally with 2,4-D acid--mostly fused ribs.

28. Commoner, B., and R.E. Scott, 1976a. Accidental contamination of soil with dioxin in Missouri: effects and countermeasures. Washington U.,St. Louis. Dioxin Information Project, Scientists' Institute for Public Information, New York, N.Y. 23+ pages.

Human symptoms, but impossible to relate to dosage. There may be some evidence of vaporization (SWH).

29. Commoner, B., and R.E. Scott, 1976b. U.S. Air Force. Studies on the stability and ecological effects of TCDD (dioxin): An evaluation relative to the accidental dissemination of TCDD at Seveso, Italy. Washington U., St. Louis, Missouri. 51 pp. November 1976. Dioxin Information Project. Scientists' Institute for Public Information. New York, New York.

TCDD:

1) 1/2 life in soil 190-330 days--logarithmic decay rate ~ constant up to 1150 days.

2) enhancement of degradation now shown.

3) vertical migration in soil does not occur.

4) TCDD higher in mouse livers and meadowlark livers than in soil.

5) pregnant female and sexually immature mice excluded from statistics, but all spleens and livers of females enlarged in exposed population.

6) either decline in fertility or increase in fetal deaths in exposed population.

30. Courtney, C.D., and J.A. Moore, 1971. Teratology studies with 2,4,5-trichlorophenoxyacetic acid and 2,4,7,8-tetrachloro-dibenzo-p-dioxin. Toxicol. Appl. Pharmacol., 20(3): 396-403.

Cleft palates and kidney malformations observed in mice with 2,4,5-T and TCDD.

2,4,5-T not teratogenic or fetotoxic in rat, but TCDD did produce kidney anomalies.

No potentiation observed with respect to teratogenicity at 100 mg/kg 2,4,5-T, 1 ug/kg TCDD.

There may have been progressive contamination of controls (SWH).

31. Crosby, D.G., K.W. Moilanen, and A.S. Wong, 1973. Environmental generation and degradation of dibenzodioxins and dibenzofurans. Environmental Health Perspectives, 5: 259-266.

"Are chlorinated dibenzo-p-dioxins ... actually generated and destroyed ... in the real world? Regrettably, no one seems to know." (p. 264)

TCDD breaks down rapidly in purified methanol.

On generation: "... phenol derivatives such as the phenoxy herbicides also might provide the raw material,... the necessary generative reactions clearly have been demonstrated." (p. 263)

32. Crosby, D.G., and A.S. Wong, 1977. Environmental degradation of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Science, 195:1337-1338.

Loss of TCDD from Agent Orange on glass in sunlight was rapid, as was loss from Esteron. Orange was lost faster from leaf than glass, but slower from soil. Cites Helling et al., 1973, to support claim that "... TCDD does not volatilize appreciably," but this reference says volatilization is possible.

33. Crosby, D.G., A.S. Wong, J.R. Plimmer, and E.A. Woolson, 1971. Photo-decomposition of chlorinated dibenzo-p-dioxins. Science, 173: 748-749. See Crosby, Moilanen, and Wong, 1973.

34. Cunningham, H.M., and D.T. Williams, 1972. Effect of tetrachloro-dibenzo-p-dioxin on growth rate and the synthesis of lipids and proteins in rats. Bull. Environ. Contam. and Toxicol., 7(1): 45-51.

Very short-term experiment for TCDD. 10 ug/kg (3 days after dosage) lowered weight gains in male rats, decreased total lipids and phospholipids at the 99% confidence level, lowered epididymal adipose tissue and raised liver protein--largest effects on lipid synthesis at 7 days, last day observed! Only eight rats/dose.

35. Davring, L., and M. Sunner, 1971. Cytogenetic effects of 2,4,5-trichloro-phenoxy acetic acid on oogenesis and early embryogenesis in Drosophila melanogaster. Hereditas, 68(1): 115-122.

At 250 ppm 2,4,5-T (butoxyethylester) fertility decreases to about 50%; 0.1 ppm dioxine (sic).

"2,4,5-T affects the early oogenesis and causes chromosome disturbances, which may result in sterility in Drosophila melanogaster." (p. 115)

36. Dougherty, W.J., M. Herbst, and F. Coulston, 1975. The non-teratogenicity of 2,4,5-Trichlorophenoxy-acetic acid in the rhesus monkey (Macaca mulatta). Bull. Environ. Contam, and Toxicol., 13:477-482.

2,4,5-T (0.05 ppm TCDD)--pregnant rhesus monkeys (days 22-38 of gestation). At .05 mg/kg, 1 mg/kg, and 10 mg/kg, not toxic to mothers, no teratogenicity, no unhealthy infants. Apparent but not statistical increases in stillbirths and abortions (SWH). 10 animals per dose level.

37. Dougherty, R.C. and K. Piotrowska, 1976. Screening by negative chemical ionization mass spectrometry for environmental contamination with toxic residues: Application to human urines. Proc. Natl. Sci., USA, 73(6): 1777-1781.

"A limited survey of human urines indicated extensive contamination of the subjects ... with pentachlorophenol, 2,4,5-trichlorophenoxy acetic acid, other polychlorophenoxy acids. and numerous unknown compounds." "The results suggest the food chain as one significant source of the contamination." Pentachlorophenol found in 100% of human seminal fluid samples.

38. Edwards, C.A., 1970. Effects of herbicides on the soil fauna. Proc. 10th Weed Control Conf., 1970, pp. 1052-1062.

2.4.5-T, no effects on soil fauna (1 ref.).
2,4-D, no effects on soil fauna (5 refs.).

39. Emerson, J.L., D.J. Thompson, R.J. Strebing, C.G. Gerbig, and V.B. Robinson, 1971. Teratogenic studies on 2,4,5-Trichlorophenoxy-acetic acid in the rat and rabbit. Fd. Cosmet. Toxicol. 9: 395-404.

Authors conclude: "Under the conditions of this study, therefore, 2,4,5-T was not embryotoxic or teratogenic in the rat or rabbit. BUT: Sterling (1974) has pointed out the significance of the partial ossification of the 5th sternebrae at 24 mg/kg/day.

Authors cite "unpublished data" to support consideration that this variation was within "normal limits."

40. Epstein, S.S., 1970a. A family likeness. Environment, 12: 16-25.

Good popular treatment at the time.

41. Epstein, S.S., 1970b. Statement of Dr. Samuel S. Epstein, Children's Cancer Research Foundations, Inc. and Harvard Medical School, Boston. 20 pp. typewritten. U.S. Senate Hearing before the Subcommittee on Energy, Natural Resources, and the Environment of the Committee on Commerce. 15 April 1970.

Teratogenicity of 2,4,5-T.

42. Epstein, S.S., 1972. Teratological hazards due to phenoxy herbicides and dioxin contaminants. First International Meeting of the Society of Engineering Science on Pollution: Engineering and Scientific Solutions. Tel Aviv, Israel, 12-17 June 1972. 22 pp. Typewritten.

43. Epstein, S.S., and M.S. Legator, 1971. The mutagenicity of pesticides. M.I.T. Press, Cambridge. 220 pp.

"There has been no large-scale testing of pesticides for mutagenic activity ... . Most of the tests for mutagenic activity of pesticides have been done on plants ... . However, a good correlation has been demonstrated for chromosome-breaking agents tested in plant and mammalian cell systems." (pp. 65-66)

44. Firestone, D., 1973. Etiology of chick edema disease. Environmental Health Perspectives 5, 59-66.

Etiology is the science of the investigation of the causes. Dioxins (varying degrees of chlorination) contaminating animal feeds were eventually found to be the cause.

45. Foldesy, R.G., L. Mineo, and S.K. Majumdar, 1972. The effect of 2,4,5-trichlorophenoxyacetic acid on two nitrogen fixing bacteria. Proc. Pennsylvania Acad. of Sci., 46: 23-24.

Growth in broth solutions depressed by 200 ppm 2,4,5-T. Adaptation indicated after subculturing 3 times.

46. Fowler, B.S., G.W. Lucier, H.W. Brown, and O.S. McDaniel, 1973. Ultrastructural changes in rat liver cells following a single oral dose of TCDD. Environmental Health Perspectives, 5: 141-148.

A single low-level dose of TCDD has been found to exert a profound effect on both the SER and RER (smooth and rough endoplasmic reticulum) of rat liver parenchymal cells.

"Appears to be related to an induction phenomenon and changes in cellular RNA and protein metabolism." (p. 147)

47. Fullerton, R.W., M.B. Carlson, and A.R. Nolting, 1974. Report on 2,4,5-T Workshop. U.S. Dept. of Agriculture, Office of the General Counsel, Washington, D.C., 8-9 March 1974.

Submitted in 2,4,5-T Hearing.

A goldmine of who's who in the 2,4,5-T-USDA-Industry-EPA-University, et al., game. Gems of references to unpublished data!

48. Gupta, B.N., J.G. Vos, J.A. Moore, J.G. Zinkl, and B.C. Bullock, 1973. Pathologic effects of 2,3,7,8-tetrachloro-dibenzo-p-dioxin in laboratory animals. Environmental Health Perspectives, 5: 124-140.

Main target organs--THYMUS in rats, guinea pigs, and mice; liver in rats.

Thymic atrophy dose dependent within species. It was also the organ most sensitive to TCDD treatment.

In both guinea pigs and mice, the cell-mediated immune response was depressed. Lymphopenia (deficiency of lymphocytes) also occurred. Not in rats, though!

Hemorrhages were also seen with some consistency. Porphyria was not seen in rats and guinea pigs.

49. Harker, T., 1973. Pretrial brief. FIFRA Consolidated Docket #295.

Good general.

50. Harris, M.W., J.A. Moore, J.G. Vos, and B.N. Gupta, 1973. General biological effects of TCDD in laboratory animals. Environmental Health Perspectives, 5: 101-109.

"Thymus appears to be a most sensitive indicator of TCDD exposure." (p. 109)

Thymus weight--lowest dose for effect.

	Rats	Guinea Pigs	Mice
Single	5	--	10
Weekly	6X5	8X0.05	4X5
Daily	30X0.1	--	-

Female rats more sensitive than males. (p. 108)

51. Helling, C.S., A.R. Isensee, E.A. Woolson, P.D.J. Ensor, G.E. Jones, J.R. Plimmer, and P.C. Kearney, 1973. Chlorodioxins in pesticides, soils, and plants. J. of Environmental Quality, 2(2): 171-178.

Pretty good summary of Kearney (ARS, USDA) group's work. Says the TCDD at Lakeland might have blown away (eroded) and that skin, feathers, liver, and intestinal tract of eagles were not analyzed--"gradual loss from oat (by volatilization) but not from soybeans." (p. 176, my emphasis).

This paper cited by Crosby and Wong, 1977, to support statement: "Pure TCDD does not volatilize appreciably... ." No real data yet on volatilization. (SWH., Jan. 1978).

52. HEW, 1968. Deaths from chlorinated phenoxyacetic acids (2,4-D, 2,4,5-T, MCPA). Bulletin, Clearinghouse for Poison Control Centers, HEW, Public Health Service, Washington, D.C. 20201. March-Apr. 1968.

Human Symptoms.

53. HEW, 1969. Teratogenicity of pesticides. Report of the Secretary's Commission on pesticides and their relationship to environmental health. Parts I and II, Chapter 8, pp 655-677. U.S. Department of Health, Education, and Welfare.

54. HEW, 1970. 2,4,5-T. FDA Fact Sheet, Food and Drug Administration, Washington, D.C. 20204. U.S. Dept. HEW, Public Health Service, 2 pp.

History of applications for "establishment of tolerances" in food. Then (1970?), "any detectable amount" of TCDD or 2.4.5-T in food "would make the contaminated food illegal and subject to seizure ... in ... interstate commerce." "0.1 ppm limit of accuracy of present analytical procedures." 0.19 ppm in one New England milk sample (1965) and 0.29 ppm in Ohio sugar beet (1966).

55. Higginbotham, G.R., A. Huang, D. Firestone, J. Verrett, J. Ress, and A. B. Campbell, 1968. Chemical and toxicological evaluations of isolated and synthetic chloro derivatives of dibenzo-p-dioxin. Nature, 220: 702-703.

56. Hiles, R. A., and R.D. Bruce, 1976. 2,3,7,8-tetrachlorodibenzo-p-dioxin, elimination in the rat: first order or zero order? Fd. Cosmet. Toxicol., 14: 599-600.

Short critique of Piper, Rose, and Gehring, 1973a, who claimed TCDD elimination was first order and Allen, Van Miller, and Norback, 1975, who made no claim for order of the process. Based on these data, it is "impossible to distinguish the order of the process." (p. 599, abs.)

Later, Rose et al., 1976, "assume" first order in a more extensive study with rats.

57. Hiltibran, R.C., 1967. Effects of some herbicides on fertilized fish eggs and fry. Trans. Amer. Fish Soc., 96(4): 414-416.

2 ppm of silvex or 2,4-D would not greatly affect survival of eggs or fry.

PGBE ester most toxic 2,4-D and silvex formulation. Iso-octyl ester most toxic of 2,4,5-T.

58. Hook, G.E.R., J.K. Haseman, and G.W. Lucier, 1975. Induction and suppression of hepatic and extrahepatic microsomal foreign-compound-metabolizing enzyme systems by 2,3,7,8-tetrachlorodibenzo-p-dioxin. Chem.-Biol. Interactions, 10: 199-214.

Rats, rabbits, and guinea pigs:

Some enzymes suppressed, others induced. Effect on one enzyme was age related. Adult males suppressed, very young (10 days old) induced.

59. House, W.B., L.H. Goodson, H.M. Gadberry, and K.W. Dockter, 1967. Assessment of ecological effects of extensive or repeated use of herbicides. Advanced Research Projects Agency. ARPA Order No. 1086. Contract No. DAHC15-68-C-o119. (Midwest Research Institute--MRI Project No. 3103-B) Herbicides in Forestry, pp. 52-71.

Definition of forest management--"The application of business methods and technical forestry principles to the operation of a forest property."

Mostly older info--alternatives, acreages, history, various uses of herbicides, effects on forest ecology (all from Newton, 1967), on forest environment, residues, and wildlife effects.

60. Hurlbert, Stuart H., 1975. Secondary effects of pesticides on aquatic ecosystems. Residue Reviews, 57: 81-148.

2,4,5-T and 2,4-D:

No reduction in production of a natural estuarine phytoplankton assemblage--4 hrs. at 1000 ppb. By Butler, 1963 (p. 98)

2,4,5-T: 0.50 ppm, 48 hr LC_{50} Bluegill.

61. Hussain, S., L. Ehrenberg, G. Lofroth, and T. Gejvall, 1972. Mutagenic effects of TCDD on bacterial systems. AMBIO 1(1): 32-33.

"Strong mutagenic action of TCDD demonstrated here."

2 ug/ml mutated Escherichia coli (reversion of streptomycin independency).

3 ug/,l mutated (reversion to histidine prototrophy) Salmonella typhimurium. Up to 10^5-10^6/10^8 mutants (at low survival rates).

"TCDD resembles ... other compounds which induce mutations through intercalation in DNA." (p. 32)

Critique--TCDD concentration (in DMSO) much higher than water solubility (Helling et al., 1973).

62. Hwang, S.W., 1973. Effect of 2,3,7,8-tetrachlorodibenzo-p-dioxin on the biliary excretion of Indocynanine green in rat. Environmental Health Perspectives 5: 227-231.

"TCDD inhibited hepatobiliary excretion of ICG and the inhibitory effect appeared to be a long lasting one." (p. 230)

63. Innes, J.R.M., B.M. Ulland, M.G. Valerio, L. Petrocelli, L. Fishbein, E.R. Hart, A.J. Palotta, R.R. Bates, H.L. Falk, J.J. Gart, M. Klein, I. Mitchell, and J. Peters, 1969. Bioassay of pesticides and industrial chemicals for tumorigenicity in mice: a preliminary note. J. Nat. Cancer Inst. 42: 1101.

64. Isensee, A.R., and G.E. Jones, 1971. Absorption and translocation of root and foliage applied 2,4-dichlorophenol, 2,7-dichlorodibenzo-p-dioxin, and 2,3,7,8-tetrachlorodibenzo-p-dioxin. J. Agr. Food Chem. 19(6): 1210-1214.

Original data on uptake from nutrient solution, soil, and foliage by oats and soybeans. Note contamination of controls with TCDD (Table II) and effect of surfactant on washoff (pp. 1213-1214). Soybeans harvested, "not fully ripe" at 50 days contained .004 ug TCDD/g of bean. $>$ 1.8 ug TCDD/lb of soybeans from soil containing 60 ppb (.06 ppm).

65. Isensee, A.R., and G.E. Jones, 1975. Distribution of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in aquatic model ecosystem. Environmental Science and Technology, 9(7): 668-672.

"TCDD accumulation by all organisms was directly related to water concentration (0.05-1330 ppt)."

Tissue conc./water conc.=algae $\sim$ 9500, duckweed $\sim$ 3500, snails $\sim$ 25,000, daphnids $\sim$ 25,000, gambusia (mosquito fish) $\sim$ 40,000, and catfish $\sim$ 15,000. Difficult to determine if true steady state was reached--gambusia exposed 3 days near end; catfish 6 days after other organisms were removed!

66. Jackson, J. B., 1966. Toxicologic studies on a new herbicide in sheep and cattle. (Publication source not given.)

72 mg/kg/day (30 daily doses) of Tordon (4-amino-3,5,6-trichloropicolinic acid) caused no signs of toxicosis in sheep, but 36 mg/kg/day combined with 134 mg/kg/day of 2,4-D killed 4 sheep in just 5 doses. With 1/5 of this combined dose (30 days) showed no signs of toxicosis. Possible but inconclusive evidence for synergism.

67. Jackson, W.T., 1972. Regulation of Mitosis. III. Cytological effects of 2,4,5-trichlorophenoxyacetic acid and of dioxin contaminants in the 2,4,5-T formulations. J. Cell. Sci., 10: 15-25.

0.2 ppb TCDD caused inhibition of mitosis and cytological abnormalities in cells of the African blood lily. Significance unknown.

68. Johnson, J.E., 1971. The public health implications of widespread use of the phenoxy herbicides and picloram. Bioscience 21(17):

Dr. Johnson was Vice President and Director of Research with Dow Chemical USA. Industry whitewash.

69. Johnson, R.L., P.J. Gehrig, R.J. Kociba, and B.A. Schwetz, 1973. Chlorinated dibenzodioxins and pentachlorophenol. Environmental Health Perspectives, 5: 171-175.

Currently available commercial grade penta contains: 2,3,7,8-tetrachlorodibenzo-p-dioxin < .05 ppm, Hexa - 9-27 ppm, octa - 575-2510 ppm. Hepta detected but not quantified.

70. Jones, E.L., and H.A. Krizek, 1962. A technique for testing acnegenic potency in rabbits, applied to the potent acnegen 2,3,7,8-tetrachlorodibenzo-p-bioxin. J. Invest. Derm., 39:511-

71. Jones, G., 1975. A histochemical study of the liver lesion induced by 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin) in rats. J. Path., 116(2): 101-105.

Male rats, single oral dose of 200 ug/kg, observed for 9 months.

Parenchymal (essential) cell plasma membrane is specific subcellular site of the toxic action of dioxin.

72. Jones, G., and W.H. Butler, 1974. A morphological study of the liver lesion induced by 2,3,7,8-tetrachloro-dibenzo-p-dioxin in rats. J. Pathology, 112: 93-97.

"a specific subcellular site of action for (dioxin)" demonstrated. Single oral dose of 200 ug/kg produces death of essential cells.

73. Jones, G., and J.G. Grieg, 1975. Pathological changes in the liver of mice given 2,3,7,8-tetrachloro-dibenzo-p-dioxin. Separatum Experientia, 31: 1315-1316.

Male mice: 35 day LD_{50}= 126 ug/kg (86-183 ug/kg, 95% confidence); mean time to death, 21 days. Liver lesions "differ in many respects from the liver lesion induced in rats by dioxin." Loss of body weight also observed.

74. Kearney, P.C., 1975. The dioxin story: Is 2,4,5-T safe? Weeds Today 6(4): 16-17.

"We can continue to ... expand the whole technology of chemical weed control." (p. 17)

Note error in describing soybean data (there was some in the harvested soybeans), lack of qualifier to rain wash data (surfactant influenced), and citation of "recent field monitoring data (Crummett?) to question laboratory bioaccumulation data. The field data is still unpublished. See Helling et al., 1973.

75. Kearney, P.C., A.R. Isensee, C.S. Helling, E.A. Wollson, and J.R. Plimmer, 1973. Environmental Significance of Chlorodioxins. pp. 105-111 In: Blair, E.H. (ed) Chlorodioxins - Origin and Fate. American Chemical Society, Advances in Chemistry Series, No. 120. 141 pp.

Note: scatter in persistence data (Figures 1 and 2) (detection limit 0.2 ppm).

See Isensee and Jones, 1971, for true story on oats and soybeans.

Note: This symposium was in 1971 - thus this is actually an earlier paper than the publishing data indicates.

76. Kearney, P.C., E.A. Woolson, and E.P. Ellington, Jr., 1972. Persistance and metabolism of chlorodioxins in soils. Environ. Sci. Tech., 6(12): 1017-1019.

See Helling et al., 1973.

77. Kearney, P.C., E.A. Woolson, A.R. Isensee, and C.S. Helling, 1973. Tetrachlorodibenzodioxin in the environment: Sources, fate, and decontamination. Environmental Health Perspectives, Experimental Issue No. 5, p. 273-277.

Figure 1 shows loss of market for 2,4,5-T when military use banned.

Figure 2 shows concentrations of dioxin in agent orange stored after the war. 68% contained < 0.5 ppm.

Note that Lakeland sand residue data (p. 215) is unreferenced and that up to 1.5 ppb was found 9-10 years later (Commoner and Scott, 1976b).

78. Kimbrough, R.D., 1972. Toxicity of chlorinated hydrocarbons and related compounds. Arch. Path., 94: 125-131.

Review - chloracne, liver disease, x-disease in cattle, chick edema, teratogenesis.

79. Kimmig, J., and K.H. Schultz, 1957a. Chlorinated aromatic cyclic ethers as a cause of the so-called chloracne. Naturwissenschaften, 44: 337-338. (Ger.)

Rabbit ear test.

2,3,6,7-tetrachlorodibenzodioxin vs. 2,3,7,8-tetrachlorodibenzodioxin. From Environmental Health Perspectives, 5 bibliography.

Note that TCDD is a cyclic ether.

80. Kimmig, J., and K.H. Schulz, 1957b. Occupational acne (so-called chloracne) due to chlorinated aromatic cyclic ethers. Dermatologia, 115(4): 540-546 (Ger.).

Raise question of 2,3,6,7-tetrachlorodibenzodioxin vs. 2,3,7,8. 31 workers studied. From EHP bibliography.

81. Knight, G.F., 1972. Testimony regarding use of simazine in Los Angeles County. 5 April 1972. Board of Supervisors, L.A. County.
Addendum, 11 May 1972.
Addendum to Addendum, 23 May 1972.
Human health, particularly hypersensitivity.

82. Kociba, R.J., P.A. Keeler, C.N. Park, and P.J. Gehring, 1976. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD): Results of a 13-week oral toxicity study in rats. Toxicology and Applied Pharmacology, 35: 553-574.

Small number of test animals (rats) makes statistical significance unlikely at lower dose levels. Plots of a) Coproporphyrin/Creatinine for Females (F); Uroporphyrin/Creatinine (F); δ-amino-levulinic acid (F); Direct bilirubin (F); liver/body weight (M + F), and thymus/body weight from their tables show that at 0.01 ug/kg/day, the "no discernible ill effect" level, dose/response relationships are seen.

Note also - lymph tissue of chicken and money affected earlier and more severely than that of rat (Norback and Allen, 1973). Also, cell mediated immune response depressed for both guinea pigs and mice, but not for rats (Gupta et al., 1973). Also - that the thymus was the organ most sensitive to TCDD in guinea pigs, mice and rats (Gupta et al., 1973). The depression of thymus weight/body weight for females is observed to be depressed relative to controls even at .001 ug/kg/day, but this is not statistically significant.

83. Koschier, F.J., and W.O. Berndt, 1976. In vitro uptake of organic ions by renal cortical tissue of rats treated acutely with 2,4,5-Trichlorophenoxyacetic acid. Toxicol. and Appl. Pharmacol., 35: 355-364.

"Pretreatment with 2,4,5-T has a depressive influence on the transport of some organic ions." (abs.)

"These data may indicate that the organic acid herbicides are, at least in part, being transported by a system separate from the classical organic anion transport process." (p.362)

"Prolonged half-life of 2,4,5-T at higher doses" checks out.

"High fetal stores of 2,4,5-T (despite reduction of maternal stores)" (p.363).

$<$.05 ppm TCDD.

84. Langer, H.G., T.P. Brady, and P.R. Briggs, 1973. Formation of dibenzo dioxins and other condensation products from chlorinated phenols and derivatives. Environmental Health Perspectives, 5: 3-8.

0.13% yield TCDD from heating 2,4,5-T, H_2O and K_2CO_3 up to 400° C.

Point out that Buu-Hoi (1971b) misidentified the mass spectrum for 2,3,7,8 TCDD.

85. Lucier, G.W., O.S. McDaniel, G.E.R. Hoor, B.A. Fowler, B.R. Sonawane, and E. Faeder, 1973. TCDD-induced changes in rat liver microsomal enzymes. Environmental Health Perspectives 5: 199-209.

Extremely potent effect on some enzymes - females may be more susceptible.

One enzyme increased 683% by single dose of 0.2 ug/kg.

Work that needs to be done: determine if maternal exposure to TCDD induces fetal enzymes and study possible relationships between enzyme induction and teratogenicity.

86. Mantel, N., N.R. Bohidar, C.C. Brown, J.L. Ciminera, and J.W. Tukey, 1975. An improved Mantel-Bryan procedure for "safety" testing of carcinogens. Cancer Research 35: 865-872.

1 in 100 million (10^{-8}) risk "is not accepted as suitably low" -- extrapolating "by a conservative rule" to "quantitative" $< 10^{-8}$ risk.

87. Matsumura, F., and H.J. Benezet, 1973. Studies on the bioaccumulation and microbial degradation of 2,3,7,8-tetrachlorodibenzo-p-dioxin. Environmental Health Perspectives, 5: 253-258.

Shows lack of vertical translocation and occurence of bioaccumulation in model ecosystems. Note that the correct concentration factor for fish in Table 5 is 540, not 54.

Mosquito larvae concentrate TCDD 9000 times.

88. Meselson, M.S., A.H. Westing, and J.D. Constable, 1972. Background material relevant to presentation at the 1970 annual meeting of the AAAS, U.S. Congressional Record, 118(6): 6807-6813.

89. Miller, R.A., 1974. The chronic toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) to five selected aquatic organisms. M.S. thesis, Oregon State University. 62 numb. leaves.

See Miller, Norris and Hawkes, 1973.

Most of these data are presented in that paper.

90. Miller, R.A., L.A. Norris, and C.L. Hawkes, 1973. Toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in aquatic organisms. Environmental Health Perspectives, 5: 177-186.

Young coho salmon, exposed for as little as 24 hours, showed decreased survival at exposure of 5.4 ng TCDD/g wet body weight (Figure 4). Growth of young coho salmon exposed to 13.1 ng/g for 96 hours was markedly reduced even after 80 days (Figure 2). 6.3 ug TCDD/~16 g dry weight young ranbow trout/week in food produced deaths beginning at 33 days, declining appetite at 10 days and finnecrosis at 14 days. Growth was suppressed even after just 6 days.

"Small fish are more sensitive than large fish on an equivalent exposure level basis."

0.2 ppb in water reduced reproductive success of a snail and a worm.

"Considerable work remains to be done."

91. Milnes, M.H., 1971. Formation of 2,3,7,8-tetrachlorodibenzodioxin by thermal decomposition of sodium 2,4,5-trichlorophenate. Nature, 232: 395-396.

Hydrolysis of 1,2,4,5-tetrachlorobenzene in ethylene glycol, with caustic soda at atmospheric pressure became exothermic and proceeded rapidly to 410°C. 2,3,7,8-tetrachlorodibenzodioxin was sublined to some extent (4%), but most was found in the residue.

92. Moffett, J.O., H.L. Morton, and R.H. MacDonald, 1972. Toxicity of some herbicidal sprays to honey bees. 1972. J. Econom. Entomology, 65(1): 32-36.

2,4-D; 2,4,5-T; silvex.

Diesel oil is toxic to bees, obscuring the effects of herbicides.

93. Moore, J.A. (ed.), 1973. Perspectives on chlorinated dibenzodioxins and dibenzofurans. Environmental Health Perspectives, Experimental Issue No. 5., U.S. Public Health Service. 312 pp. "EHP"

This volume is a good starting place for background. Many papers are individually referenced here. Bibliography.

94. Moore, J.A., B.N. Gupta, J.G. Zinkl, and J.G. Vos, 1973. Postnatal effects of maternal exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Environmental Health Perspectives, 5: 81-85.

"It was hypothesized that the prenatal and postnatal kidney anomaly are of the common etiology (assignment of cause) and that the incidence and degree of hydronephrosis (accumulation of water in the kidneys) is a function of dose and length of target organ exposure." (p. 85)

Note the effects of TCDD are here shown to be passed from mother to newborn, obviously in the milk. TCDD was not actually looked for in the milk.

"Failure to mention possible thymus effects in a paper dealing with TCDD exposure would be misleading." "...there appears to be a reduction in thymus weight at birth in some pups from females treated with TCDD during pregnancy. In postnatal studies, there was a dose related thymus weight decrease when compared to controls in pups weaned from mothers who received 10 or 3 ug/kg TCDD at parturition."

95. Morton, H.L., and J.O. Moffett, 1972. Ovicidal and larvicidal effects of certain herbicides on honey bees. Environmental Entomology, 1 (3): 611-614.

At 1000 ppm in 60% sucrose-water "2,40D, 2,4,5-T, Silvex, 2,4-DB and EPTC severely reduced or eliminated brood production..." phenoxys reduced brood production at 100 ppm but "T" did not at 10 ppm. Only temporary reduction claimed, but data not given.

96. Muranyi-Kovacs, I., G. Rudali, and J. Imbert, 1976. Bioassay of 2,4,5-Trichlorophenoxy-acetic acid for carcinogenicity in mice. British J. Cancer, 33: 626-633.

80 ppm in diet (<0.05 ppm dioxins) produced significant increase in "non-incidental tumors" in C3HF mice (both female and male) but not in XVII/G mice. Data is treated by age specific method. In females, increase in non-incidental (n-i) tumors produced a decrease in survival time. 1/2 of n-i tumors appears in first 18 months in treated mice - none in controls in first 18 months. Mouse (rodent) expected to excrete T Rapidly -- rat half time 4.7 hours at 5 mg/kg vs. 23 hours for man.

97. NAS, NRC, 1974. The effects of herbicides in South Vietnam. Part A. Summary and Conclusions. National Academy of Sciences, National Research Council, Washington. pp.

"Given the limitation of time, resources, and safety under which the committee was working in SVN it was not possible to investigate whether all these potential effects had or had not occurred, nor was it always possible to separate effects of herbicides from the effects of the complex of war-related changes in recent years in Vietnam." (p. VII-1)

"...the circumstances were such that an appreciable increase in the malformation rate in the offspring of sprayed individuals could have remained undetected by our investigation." (p. VII-6)

"The reports of serious deleterious consequences of herbicide spraying on humans, animals, and plants are internally consistent." ... "Reports of human illness following spraying are so striking it is difficult to dismiss them as simply the effects of propaganda, high normal death rates, or faulty understanding of cause and effect." (p. VII-66).

98. Neubert, D., P. Zens, A. Rothenwallner, and H.J. Merker, 1973. A survey of the embryotoxic effects of TCDD in mammalian species. Environmental Health Perspectives, 5: 67-79.

TCDD potentiates other teratogens which do not potentiate each other.

Using fractions of teratogenic doses of TCDD and 2,4,5-T:

TCDD	2,4,5-T	Cleft Palate obs.	Reference
1/20-1/50	1	potentiated	p.77
.8	.6	potentiated	p.78
.5	.5	not potentiated	p.78
.5	.5+	potentiated	p.78
.1	Other teratogens	not potentiated	p.78

Good data treatment and experimental design (SWH).

91. Milnes, M.H., 1971. Formation of 2,3,7,8-tetrachlorodibenzodioxin by thermal decomposition of sodium 2,4,5-trichlorophenate. Nature, 232: 395-396.

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.5	.5	not potentiated	p.78
.5	.5+	potentiated	p.78
.1	Other teratogens	not potentiated	p.78

Good data treatment and experimental design (SWH).

99. Nilsson, C.A., K. Anderson, C. Rappe, and S.V. Westermark, 1974. Chromatographic evidence for the formation of chlorodioxins from chloro-2-phenoxyphenols. J. Chromatogr., 96: 137-147

Pyrolysis of pehnoxyphenols yielded dioxins.

100. Norback, D.H., and J.R. Allen, 1969. Morphogenesis of toxic fat induced concentric membrane arrays in rat hepatocytes. Lab Invest., 20: 338-346.

See Van Miller, Marlar and Allen, 1976.

101. Norback, D.H., and J.R. Allen, 1973. Biological responses of the non-human primate, chicken and rat to chlorinated dibenzo-p-dioxin ingestion. Environmental Health Perspectives, 5: 233-240.

Symptoms: (note, apparently only males tested)
mortality: chicken > monkey > rat
extracellular fluid: chicken, monkey
gastric ulcers: monkey
chloracne: monkey
lymph tissue/bone marrow depletion: chicken, monkey > rat
therefore, reduced resistance!
semen production reduced: monkey, chicken
liver enlargement: chicken > monkey > rat

102. Norris, L.A., and R.A. Miller, 1974. The toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in guppies (poecilia reticulatus Peters). Bull. Environ. Contam. and Toxic., 12(1): 76-80.

120 hour exposure -- all dead in 37 days at 0.1 ppb, in 30 days at 1.0 ppb, in 35 days at 10.0 ppb.

My conclusion (SWH) - even 0.1 ppb, lowest dose tested, is a kinetically determined zap to 100% of the guppies.

Also see Miller, Norris and Hawkes, 1973.

103. Norris, L.A., M.L. Montgomery, and E.R. Johnson, 1975. Residues of 2,4,5-T in the forest. (Abstr.) Proc. Weed Sci. Soc., p. 23

"Aerial application of 2,4,5-T isoctyl ester at 2 lb/A."

Initial concentrations: 11 ppm by weight in vine maple, 115 ppm in grass. After one month, 0.5 to 11 ppm; after 1 year, < 0.5 ppm.

In "forest floor," 0.3 lb/A initially, and at 1 month; .03 lb/A at 6 months, 0.02 lb/A at 1 year.

"Little leaching" "from forest floor into soil." No residues found deeper than 12 inches, but no data on weather given. Maximum in soil = 1 ppm.

104. Oliver, R.M., 1975. Toxic effects of 2,3,7,8-tetrachlorodibenzo 1,4 dioxin in laboratory workers. *Brit. J. Indust. Med.*, 32: 49-53.

Three young scientists, each with transient minimal exposure to TCDD: Two got typical chloracne, two had delayed symptoms (up to two years) including "personality changes, other neurological disturbances, and hirsutism."

105. Piper, W.N., J.Q. Rose, and P.J. Gehring, 1973a. Excretion and tissue distribution of 2,3,7,8-tetrachlorodibenzo-p-dioxin in the rat. *Environmental Health Perspectives*, 5: 241-244.

Also see 1973b.

TCDD is immediately absorbed from the gastrointestinal tract.

Most TCDD localized in liver and fat. Dose used (50 ug/kg) was twice the LD_{50} which may have affected the excretion rates. Presence of TCDD C^{14} in expired air and urine is taken as evidence of "some metabolic alteration or break-down of TCDD" ... but note that total by those two routes was 8.8+ (?)% and the TCDD administered was only 93.3 to 95.0% pure. (SWH calculation from Figure 1)

See also Hiles and Bruce, 1976.

106. Piper, W.N., J.Q. Rose, and P.J. Gehring, 1973b. Excretion and tissue distribution of 2,3,7,8-tetrachlorodibenzo-p-dioxin in the rat. pp. 85-91. In: Blair, E.H. (ed.) *Chlorodioxins - origin and fate*. American Chemical Society, Advance in Chemistry Series, 120.

Essentially the same paper as 1973a.

107. Poland, A., and E. Glover, 1973a. 2,3,7,8-tetrachlorodibenzo-p-dioxins: a potent inducer of δ-aminolevulinic acid synthetase. *Science*, 179: 476-477.

Increase in enzyme activity in check embryo at $5x10^{-12}$ mole/egg. Effect is dose related and prolonged in time.

"...it seems most likely that the outbreak of PCT in workers in the factory producing 2,4,5-T is attributable to induction of hepatic ALA synthetase by TCDD." (p. 477)

PCT is porphyria cutanea tarda, a dark red or purple discoloration of the skin.

108. Poland, A., and E. Glover, 1973b. Studies on the mechanism of toxicity of the chlorinated dibenzo-p-dioxins. *Env. Health Persp.*, 5: 245-251.

1) TCDD is a nearly planar, highly lipophilic, and rather chemically unreactive molecule with remarkable biologic potency and hence specificity.

2) TCDD elicits very large differences in susceptibility of different species.

3) TCDD produces different patterns of histologic damage in different species.

4) TCDD is remarkably slow in its toxic action.
5) TCDD is an extraordinarily potent teratogen in a number of species.
6) aryl hydrocarbon hydroxylase activity correlates with toxicity.

109. Poland, A.P., E. Glover, J.R. Robinson, and D.W. Nebert, 1974. Genetic expression of aryl hydrocarbon hydroxylase activity. Induction of mono-oxygenase activities and cytochrome P_1-450 formation by 2,3,7,8-tetrachlorodibenzo-p-dioxin in mice genetically nonresponsive to other aromatic hydrocarbons. J. Biol. Chem., 249(17): 5599-5606.

Some inbred strains of mice are "nonresponsive" to many aromatic hydrocarbons, but not to TCDD!

110. Poland, A., and A. Kende, 1976. 2,3,7,8-tetrachlorodibenzo-p-dioxin: environmental contaminant and molecular probe. Fed. Proc., 35(12): 2404-2411.
Mechanisms of toxicity.

111. Poland, A.P., D. Smith, G. Metter, and P. Possick, 1971. A health survey of workers in a 2,4-D and 2,4,5-T plant. Archives of Environmental Health, 22: 316-327.
13/73 of 2,4,5-T factory workers had chloracne. "Severity of chloracne correlated significantly with the presence of hyperpigmentation, hirsutism, eye irritation, and a high score on the manic scale of the Minnesota Multiphasic Personality Inventory." (Abs.)

112. PSAC, 1971. Report on 2,4,5-T. A report of the panel on herbicides of the President's Science Advisory Committee, Executive Office of the President, Office of Science and Technology. March, 1971. 68 pp.
"Government must act on the side of prudence." (Letter of transmittal)
Good review of general aspects of 2,4,5-T problem: chemistry, uses and significance, toxicology, residues in the environment, and "some" ecological effects.

113. Rappe, C., and C.A. Nilsson, 1972. An artifact in the gas chromatographic determination of impurities in pentachlorophenol. J. Chromatogr., 67: 247-253.
OCDD can be formed in the heated injection block of the gas chromatograph.

114. Rose, J.Q., J.C. Ramsey, T.H. Wentzler, R.A. Hummel, and P.J. Gehring, 1976. The fate of 2,3,7,8-Tetrachlorodibenzo-p-dioxin following single and repeated oral doses to the rat. Toxicology and Applied Pharmacology, 36: 209-226.

The data on concentrations of TCDD in tissues (Table 4), if plotted linear concentration/linear time appear to be increasing in thymus and liver at 7 weeks. Extrapolation from three data points (1,3,7 weeks) to a steady state is subject to large errors. Conclusion of 13 weeks to steady state applies only to the organs or parts of the body to which it has been shown to apply, not to all.

115. Saint-Ruf, G., 1972. Formation of "dioxin" in the pyrolysis of sodium alpha-(2,4,5-trichlorophenoxy)-propionate. Naturwissenschaften, 59(12): 648.

From silvex -- may be based on the misidentification of TCDD by mass spec.

116. Sare, W.M., and P.I. Forbes, 1972. Possible dysmorphogenic effects of an agricultural chemical: 2,4,5-T. New Zealand Medical Journal, 75(476): 37-38.

If humans have the same sensitivity as rats, a pregnant woman would need to ingest, at the "right time," only about 8×10^{-6} gm dioxin, "to expect a deformed baby." (p.38)

Two deformed babies observed from drift onto roofs and washing into water supplies. "Obviously we cannot prove, BUT..."

Cows also had low calving rate.

117. Schulz, K.H., 1957. Clinical and experimental studies on the etiology of chloracne. Archiklin. Exp. Derm. 206: 589-596.

Chloracne ascribed to TCDD.

Human symptoms (ref., EHP)

10 ug of 2,3,6,7-TCDD applied to human skin produced chloracne-like symptoms.

(ref., Kimbrough, 1972).

118. Schwetz, B.A., J.M. Norris, G.L. Sparschu, V.K. Rowe, P.J. Gehring, J.L. Emerson, and E.G. Gerbig, 1973. Toxicology of chlorinated dibenzo-p-dioxins. Environmental Health Perspectives, 5: 87-99.

Tested 2,3,7,8 and other dioxins.

TCDD LD_{50}'s (single oral):

male rat 0.022 mg/kg
female rat 0.045 mg/kg
male guinea pig 0.0006 mg/kg 91% pure TCDD
male guinea pig 0.0021 mg/kg 99% pure TCDD
rabbits .115 (wide variation)
skin application: .275
mice - a few sporadic deaths, data not given

Also give maternal and fetal measurements, resorptions for di-,hexa-and octa-; fetal anomalies for TCDD, and chick edema bioassay. Isomers differ in toxicological properties ($1,2,3,4 \neq 2,3,7,8$).

119. Shoecraft, Billee, 1971. Sue the bastards. Franklin Press, Phoenix. 464 pp.

2,4,5-T silvex damage to human community described. Ms. Shoecraft has since died of cancer which her husband, Willard, claims was caused by the herbicides.

120. Sjoden, P.O., and U. Soderberg, 1972. Sex-dependent effects of prenatal 2,4,5-trichlorophenoxy acetic acid on rats open-field behavior. Physiology and Behavior, 9: 357-360.

Rats: treated 25 mothers (single oral dose, day 7, 8 or 9 of pregnancy -- offspring tested at 90 days) males significantly more explorative than controls.

Dosage: 100 mg/kg, <1 ppm TCDD, no anatomical abnormalities. "...direct effects on gross metabolism of the offspring perinatally, could safely be excluded".

Same for nursing effects (23 days, weaned).

"a 'selection effect' would presumably affect male and female offspring alike." (p. 360)

121. Sparschu, G.L., F.L. Dunn, R.W. Lisowe, and V.K. Rowe, 1971. Study on the effects of high levels of 2,4,5-T on fetal development in the rat. Fd. Cosmet. Toxicol., 9: 527-530.

Dosed days 6-15 with 2,4,5-T (0.5 ppm TCDD, same batch as Emerson, et al., 1971).

Body weights:	day 6		day 13	day 20
Control:	264	+29	293	388
50 mg/kg/day:	271	+11	282	382

Conclusion - decreased weight gain during dosing.

Table 3 -- 50 mg/kg/day - increased resorptions - (fetuses absorbed/total #); delay in ossification (hardening) of the skull bones at 50 mg/kg/day.

Cites Dow unpublished data, 1971 saying that "smilarly delayed ossification has been observed in 20-day-old fetuses, "with no difference" in ossification of the skeletons of 3 week old neonates.

122. Sparschu, G.L., F.L., Dunn, and V.K. Rowe, 1971. Study of the teratogenicity of 2,3,7,8-Tetrachlorodibenzo-o-dioxin in the rat. Food and Cosmetics Toxicology, 9: 405-412.

"No adverse effect on the fetuses was noted at the 0.03 ug/kg level ..." (abs) Dose/day, days 6-15 of pregnancy.

Only 10 rats at that level, however.

123. Stehl, R.H., and L.L. Lamparski, 1977. Combustion of several 2,4,5-Trichlorophenoxy compounds: Formation of 2,3,7,8-Tetrachlorodibenzo-p-dioxin. Science, 197: 1008-1009.

Combust grass treated with Esteron 2,4,5®; convert .00016% of 2,4,5-T to TCDD. No difference between grass burned immediately after treatment and grass burned one week after treatment. Therefore, spray and burn is equivalent to spraying with 2,4,5-T containing 1.6 ppm TCDD.

124. Stehl, R.H., R.R. Papenfuss, R.A. Bredbeweg, and R.W. Roberts, 1973. The stability of pentachlorophenol and chlorinated dioxins to sunlight, heat, and combustion. pp. 119-125. In: Blair, E.H. (ed.) Chlorodioxins - Origin and fate, American Chemical Society, Advances in Chemistry Series 120, 141 pp.

Decomposition of 2,3,7,8-tetrachlorodibenzo-p-dioxin.

T°C	21 sec exposure % decomposition		50 sec exposure % decomposition
500	39 = %	not in	42
600	40	benzene	59
700	50	at end	53
800	99.5		

2,3,7,8- probably stable toward air oxidation.

125. Sterling, T.D., 1970. Problems in determining if a commonly used herbicide (2,4,5-T) has an effect on human health. Proc. Sixth Berkeley Symposium on Mathematical Statistics and Probability, pp. 479-494.

Good critique of studies to that time.
See Sterling, 1971.

126. Sterling, T.D., 1971. Difficulty of evaluating the toxicity and teratogenicity of 2,4,5-T from existing animal experiments. Science, 174: 1358-1359.

Good concise statement of basic argument at that time.

127. Sterling, T.D., 1974. Toxic and teratogenic effects of 2,4,5-trichlorophenoxyacetic acid and 2,3,7,8-tetrachlorodibenzo-p-dioxin. Summary of evidence presented to the Royal Commission hearings on herbicides and pesticides, July 16, 1974, and to hearings of the Assembly Committee on Natural Resources of the State of Wisconsin, March 19, 1975. 24 typewritten pages.

Most specific of Sterling's papers: Dow Chemical Company has put out a page-by-page attack on this paper. Sterling's basic argument is that levels at which statistical significance is obtained may be determined by sample size.

128. Thigpen, J.E., R.E. Faith, E.E. McConnell, and J.A. Moore, 1975. Increased susceptibility to bacterial infection as a sequela of exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin. Infection and Immunity, 12(6): 1319-1324.

1 ug/kg/wk for 4 weeks increased susceptibility of mice to bacterial challenge - levels which "do not produce clinical or pathological change still have the capacity to affect host defense..." (p.1322)

129. Thompson, D.J., J.L. Emerson, and G.L. Sparschu, 1971. Study of the effects of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) on rat and rabbit fetal development. Teratology, 4(2): 243 (abs.)

No effects at 50 mg/kg/day, days 6-15 rats.

No effects at 40 mg/kg/day, days 6-18, rabbits.

100 mg/kg/day, days 6-10 produced maternal toxicity and death, complete resorption, but no terata.

130. Tung, Ton That, 1973. Le cancer primaire due foie an Viet-nam. Chirurgie, 99: 427- .

"...occular and nervous system lesions, spontaneous abortions, trisomy 21, and other congenital malformations have been observed..."

See Muranyi-Kovacs, Rudali and Imbert, 1976.

131. USDA, Forest Service, 1977 (EIS). Vegetation management with herbicides. USDA Forest Service Environmental Statement, Region Six. Draft.

For period 1 July 1977 to 30 September 1978. We understand that the final on this one is having trouble getting out. (Now expected Feb. 1978.)

132. Van Miller, J.P., J.J. Lalich, and J.R. Allen, 1977. Increased incidence of neoplasms in rats exposed to low levels of 2,4,7,8-tetrachlorodibenzo-p-dioxin. Chemosphere Preprint.

133. Van Miller, J.P., R.J. Marlar, and J.R. Allen, 1976. Tissue distribution and excretion of tritiated tetrachloro-dibenzo-p-dioxin in non-human primates and rats. Food and Cosmetics Toxicology, 14: 31-34.

Tissue distribution different in rats and monkeys:

40% of dose localized in rat liver after 7 days while <10% localized in monkey livers. Monkeys have most in muscle, skin and fat.

Absorption from the gastro-intestinal tract, from hip injections, and rate and routes of excretion of TCDD are similar, however.

"These compounds are, at best, not readily metabolized." (p.33)

Note that this is a short term (7-day) study.

134. Vinopal, J.H., and J.E. Casida, 1973. Metabolic stability of 2,3,7,8-tetrachlorodibenzo-p-dioxin in mammalian liver microsomal systems and in living mice. Arch. Env. Contam. and Tox., 1(2): 122-132.

TCDD not converted to water-soluble product by microsome-NADPH systems prepared from mouse, rat and rabbit livers, or by living mice.

"The metabolic stability and localization (in the liver) of (TCDD) indicate that the unmetabolized compounds, rather than a metabolite, probably is responsible for its toxic effects in mammals and that the endoplasmic reticulum of the liver is a possible site of action." (Abs., p. 122)

135. von Rumker, R., E.W. Lawless, and A.F. Meiners, 1974. Production, distribution, use and environmental impact potential of selected pesticides. Study for EPA, OPP. EPA 540/1-74-001.

2,4-D case study (lots), tables of "pesticide priority ratings."

136. Strickland, John, and Thomas Blue, 1972. Environmental Indicators for Pesticides. 129 pp. Prepared for Council on Environmental Quality, Washington, D.C.

Some air monitoring data for phenoxy's.

137. Vos, J.G., 1977. Immune suppression as related to toxicology. CRC Critical Reviews in Toxicology, May 1977, pp. 67-101.

"...current procedures for toxicity testing underestimate the importance of the immune system: lymphoid organs and in general the immune system have been poorly examined." (p.67) TCDD is one of the "immunosuppressive chemicals" discussed (pp. 81-83.) Cites data of Thigpen et al., 1975, as showing that TCDD dose which caused increased mortality and decreases time to death in mice infected with Salmonella bern "was one order of magnitude lower than the dose that caused atrophy of the thymus." (p.82)

138. Vos, J.G., and J.A. Moore, 1974. Suppression of cellular immunity in rats and mice by maternal treatment with 2,4,7,8-tetrachlorodibenzo-p-dioxin. International Archives of Allergy and Applied Immunology, 47: 77-794.

"severe depletion of lymphocytes in the thymic cortex of the offspring. Cellular immunity was impaired in these animals..."

Thymus "main organ affected by TCDD exposure" (p.781). Discusses possible mechanisms.

"suppression of the cell-mediated immune response in rats and mice is an age-related phenomenon." (p.791) (adults, no; young, yes).

Depressed cell-mediated immunity may contribute to deaths for young rats and mice, and adult guinea pigs. (p. 791)

139. Vos, J.G., J.A. Moore, and J.G. Zinkl, 1973. Effect of 2,3,7,8-tetrachlorodibenzo-p-dioxin on the immune system of laboratory animals. Environmental Health Perspectives, 5: 149-162.

0.04 ug/kg/wk for 8 weeks significantly reduced diameters of tuberculin skin reactions in guinea pigs.

Rats at 5 ug/kg/week for 6 weeks had lower thymus weights -- guinea pig thymus weights were lower at 0.2 ug/kg/wk for 8 weeks.

"TCDD at sublethal dose levels suppresses the cell-mediated immunity in both guinea pigs and mice."

See Vos and Moore, 1974.

140. Vos, J.G., J.A. Moore, and J.G. Zinkl, 1974. Toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in C57bl/6 mice. Toxicol. Appl. Pharmacol., 29 (2): 229-241.

"in mice that died, depletion of the thymus and spleen were consistently found."

Significantly increased liver and decreased thymus weights at 1 ug/kg (once per week for 2 to 6 weeks).

TCDD caused hepatic porphyria. 0.2 ug/kg caused lipid accumulation.

NOTE: dose response curve of Thymus/body weight -- Table 1. Only 9-11 animals/group. Therefore, 0.2 ug/kg decrease (2 weeks) not statistically significant. Same critique of data in Table 2 (6 weeks), also.

141. Wilson, J.G., R.K. Boutwell, D.E Davis, F.N. Dost, W.J. Hayes, H. Kalter, T.A. Loomis, A. Schulert, T.D. Sterling, and D.L. Bowen, 1971. Report of the Advisory Committee on 2,4,5-T to the Administrator of the EPA, 7 May 1971. 76 pp.

Butler (1974) says this has data on domestic animal symptoms.

142. Woods, J.S. 1973. Studies of the effects of 2,3,7,8-Tetrachlorodibenzo-p-dioxin on mammalian hepatic δ-aminolevulinic acid synthetase.

Measured δ-ALA synthetase activity: TCDD did not alter this in male rats at 25 ug/kg (data given, G) or 100 ug/kg (data not given, NG), not in female rats (NG) or mice (NG). TCDD did not alter it in fetal and 4 and 12 day old rats either, at 25 ug/kg (G).

143. Woolson, E.A., P.D.J. Ensor, W.L. Reichel, and A.L. Young, 1973. Dioxin residues in lakeland sand and bald eagle samples. pp 112-118. In: Blair, E.H. (ed.). Chlorodioxins - Origin and fate, American Chemical Society, Advances in Chemistry Series, 120: 141 pp.

Presents data on test area C52A, Eglin AFB.

Note: soil samples in 6 inch increments. (sampled 1970 vs. 1973-74 for Commoner and Scott, 1976b).

Gives data on eagle residues, but neglects to say which tissues were not analyzed (see Helling et al., 1973, p. 1976).

50 ppb detection limit (p. 118).

144. Woolson, E.A., R.F. Thomas, and P.D.J. Ensor, 1972. Survey of polychlorodibenzo-p-dioxin content in selected pesticides. Journal of Agricultural and Food Chemistry, 20(2): 351-354.

145. Yoder, Julie, Michael Watson, and W.W. Benson, 1973. Lymphocycte chromosome analysis of agricultural workers during extensive occupational exposure to pesticides. Mutation Research, 21: 335-340.

Relative to controls:

	Chromatid gaps		Chromatid breaks	
	Off Season	Mid Season	Off Season	Mid Season
Control (N=16)	1.0	1.0	1.0	1.0
Insecticide exposure (N=16)	1.6	1.9	1.0	3.6
Herbicide exposure (N=26)	0.6	2.0	0.2	4.1

In herbicide group:

"...possibility of induced compensatory protection... during the off season...in the form of enhanced chromosomal repair."

In exposed group (total, insecticide and herbicide), one "chromatic exchange figure" per 200 cells whereas general population has 1/3000; a 15-fold increase in the exposed population. None observed in 400 control cells.

146. Young, A.L., 1974. Ecological studies on a herbicide-equipment test area (TA C-52A), Eglin AFB Reservation, Florida. Final report. Jan. 67 to Nov. 73. (Tech Report, AFATL-TR-74-12, Air Force Armament Laboratory, Eglin AFB, Florida). 141 pp.

147. Young, A.L., C.E. Thalken, and W.E. Ward, 1975. Studies of the ecological impact of repetitive aerial applications of herbicides on the ecosystem of test area C-52A, Eglin AFB, Florida. Final report, May 1973-December 1974. Report No. AFATL-TR-75-142, Air Force Armament Laboratory (DLV). Armament Development and Test Center, Eglin AFB, Florida 32542.

See Commoner and Scott, 1976b.

148. Young, A.L., C.E. Thalken, E.L. Arnold, J.M. Cupello, and L.G. Cockerham, 1976. Fate of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the environment: summary and decontamination recommendations. Report No. USAFA-TR-76-18. Dean of the Faculty, U.S. Air Force Academy. Colorado 80840.

See Commoner and Scott, 1976b.

149. Zinkl, J.G., J.G. Vos, J.A. Moore, and B.N. Gupta, 1973. Hematologic and clinical chemistry effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin in laboratory animals. Environmental Health Perspectives, 5: 111-118.

Hepatocellular necrosis (death of liver tissue) is the main toxic action of TCDD in rats.

Lymphopenia (depletion of lymphocytes in blood) may be in mice and guinea pigs.

150. Zitko, V., 1972. Absence of chlorinated dibenzodioxins and dibenzofurans from aquatic animals. Bull. Environ. Contam. Toxicol., 7: 105-110.

Detection limit 40 ppb for TCDD.

TCDD:

2,4,5-T:

COMMENTS SUBMITTED BY JAMES M. WITT

Dr. Streisinger presented a very interesting hazard evaluation of TCDD. I was very pleased that he used exactly the process--identify a no-effect level, identify the environmental exposure level, and then work out the safety margin--I described. I do, however, have some comments with parts of his interpretation:

The figures presented for levels of TCDD in fat of beef grazing on 2,4,5-T-treated pasture have been the subject of dispute for some time. Since the analysis of TCDD at the low-parts-per-trillion level involved in these samples is so very difficult, it has been agreed by the Dioxin Monitoring Working Group that they had to reach a conclusion about analytical results according to an agreed-upon process. The figures presented are the conclusions of one member of that group, and this was clearly stated; but it should also be emphasized that this is not the conclusion of the entire Working Group. The figures I have on this study show that only one sample was as high as 65 ppt (parts per trillion), only two samples as high as 20 ppt, and five samples may have been positive in the 5-10 ppt range, but the identification was uncertain. The remainder of the samples (56) from treated areas were negative. This indicates that 1/20 were certainly positive, and 1/8 may have been positive. These values appear in the April 1977 Draft EPA Dioxin: Position Document. The point is that the speculation of one member of the Dioxin Working Group should be clearly distinguished as different from the conclusions of the Working Group as a whole.

As Dr. Streisinger indicated in his footnote, there is some concern over the validity of the analysis of the samples of animals from the Siuslaw National Forest. These were analyzed in 1973 by techniques less sensitive and less reliable than those used presently. In 1976 five of the positive samples (from a total of eight or 10 positives, my copy of the report is not completely legible) were rerun, and three of the five showed positive again. The rerun values were different from the original values and the results were different between laboratories, even though they were very high values (50-100 ppt) where the problems of analytical uncertainty should not be a serious problem. The results of the original analysis were also a little puzzling in that there were a few very high values, a couple at the limit of sensitivity, and the rest were not detectable. This is an unusual distribution curve for contamination by an environmental chemical. It suggests that either a few mice and birds got into a different exposure pattern than the balance of the population or that the analyses were aberrant. In any event, it is not a good practice to generalize from these kinds of results to the population of forest animals.

However, I accept Dr. Streisinger's hypothesis that a 10-ppt level of dioxin in animal fat is useful assumption for a range-finding test

of his hazard evaluation system, but I do not believe it should be used as a conclusion. In other words, we can say "if dioxin occurs at 10 ppt . . . etc.," but we should not say "since dioxin occurs at 10 ppt . . . etc."

With regard to the calculations presented in Table 1, which are critical to the hazard evaluation, I find them to be numerically correct but have two cautions to add to their interpretation. I would like to find another term than "no-effect" dose to describe the figure in column 3, Table 1 (the dose calculated in terms of a 60-Kg human). We generally use the term "minimum-detected-effect level" to describe the least experimental dose or level used which produced an observed or detected effect and the term "no-detected-effect level" or simply "no-effect" level or dose to describe the maximum experimental dose which resulted in no observable effects. The "no-effect" dose is usually 1/10 of the MDEL, because of the way researchers set up their experiments. When we divide this by a 100-fold safety factor, we have calculated a safe level, not a level which as soon as we exceed it, we can expect to see the effects described. Dr. Streisinger stated the conditions clearly enough in his text, but I found that it was subject to misinterpretation by some of the audience. In other words, 79 meals of the hypothetical "half-pounder" hamburger would not be expected to produce a decreased weight in the thymus gland, but rather we should say that 7800 such meals certainly would produce that effect, 780 meals would in some individuals, and 78 such meals probably would not produce any effect.

Another caution about probability that should be introduced is that the likelihood that encountering a steer that grazed on treated pasture or a deer that grazed on treated brush should be expressed. This is because of the chances of an animal so exposed carrying 10 ppt of dioxin in its fat is 1 in 10, and only 1 percent (or whatever) of the animals are so exposed, then the probability of an individual making a meal from two such animals in order to achieve the necessary number of meals to get an effect are considerably less than it would first appear.

COMMENTS SUBMITTED BY MICHAEL NEWTON, LOGAN NORRIS, AND JAMES WITT

During the symposium, Drs. Meselson and Streisinger presented material that would leave one with the impression of immediate toxic hazard associated with the present uses of 2,4,5-T in forests.

Their comments were based on six items of evidence of which some were toxicological and some related to observed residues. The assumptions of hazard resulting from these reports require that very low levels of TCDD be established as dangerous, and that such levels are constant or appear regularly in the human food supply. We do not feel that either point was supported by the data cited.

Meselson and Streisinger built their cases on these reports:

1. Allen and Carsten's findings in 1967 that "toxic fat" produced severe chronic intoxication in monkeys, with the assumption that TCDD was the toxic ingredient.

2. The Van Miller and Allen study interpreted as evidence of TCDD carcinogenicity in rats at levels down to 5 parts per trillion (pptr) in the diet.

2. Allen's report that monkeys were severely intoxicated by chronic exposure to 500 pptr of TCDD, with the implication that any exposure leads to cumulative irreversible harmful effects.

4. EPA Dioxin Monitoring Program data reporting the appearance of TCDD in beef fat.

5. Meselson's report showing positive TCDD determinations in human milk.

6. Meselson's data showing the appearance of TCDD in wildlife.

During the symposium, Newton commented briefly on several of these studies. Based on recall, he expressed the opinion that the data did not necessarily support Meselson's and Streisinger's interpretations as used in their arguments. We have since had an opportunity to examine each of the studies and will add further comment on several of the data bases.

During the symposium, Newton criticized the lack of evidence that TCDD was the toxic ingredient in the "toxic fat" study of monkeys. Personnel of the Dow Analytical Chemistry Laboratories have tentatively confirmed that a contaminant other than TCDD was present and that they have an analysis of the fat. At our request, they will be forwarding these data for inclusion in this record.

The Van Miller and Allen rat study is interpreted by some, but not by its authors, as showing carcinogenicity of TCDD at 5 pptr in the diet of rats. On subsequent inspection, the criticism of this interpretation appears to be valid on the basis that (1) no data were presented about the examination of control rats, (2) the sample size of less than eight surviving rats per exposure level is inadequate for any conclusions regarding carcinogenicity, especially when survival of controls is apparently poorer than that of animals treated with less than 1000 pptr TCDD, (3) regardless of dosage rate, there were no more than two neoplasms of any single type in any dosage level, (4) these did not form a dose-response relationship, and (5) even if the oncogenesis conclusion was supportable, none of the neoplasms had metastasized, prohibiting the conclusion of direct carcinogenesis.

Meselson speculated in reference to the fate of Allen's monkeys that all animals were either killed directly by 9 months exposure to 500 pptr in the diet or they have been sacrificed. Allen's associate, Van Miller, reported at a recent Oregon State University siminar that three survivors had not only survived, they have recovered and borne young that show no effects of treatment. The ability of mammals to recover as observed in Allen's monkeys is consistent with the findings of others that mammals and fish do have the ability to recover from long-term, near-lethal exposures. This is in conflict with inferences that every dose brings the subject animals closer to terminal condition. The hypothesis of cumulative effects has not been tested. The continuous high-level exposure in Allen's study may well have overwhelmed normal detoxication and repair mechanisms in the animals that succumbed. Apparent recovery of the surviving but severely intoxicated monkeys in Allen's study indicates repair mechanisms do exist. Even if the cumulative effect hypothesis is correct, life-long exposure to possible environmental levels of TCDD from forest spraying will not result in "accumulation" of dangerous effect levels of TCDD, as evidenced by wildlife samples.

The EPA Dioxin Monitoring data were cited as illustrating that roughly a third of the beef fat samples contained measurable TCDD. In arriving at this figure, Meselson deleted all the samples recorded with low-resolution analysis. This reduced the total sample size while removing a group of non-detectable samples. His sample was entirely drawn from the group selected for high-resolution analysis because of an earlier positive indication. Thus, his statement about frequency of appearance of TCDD in the fat of beef does not refer to all U.S. beef but rather to animals which had been selected because analysis of their fat had already shown an indication of being positive and from animals known to have grazed on treated pasture. It is not surprising that this subset of determinations showed higher than everage percentages of "positives." The deletion of low-resolution samples as non-relevant implies that the low-resolution method will not give dependable determinations of "negatives." It is clear that a negative is a true negative by either method but that the low resolution method is less precise in quantitative positive detection, especially where there are interfering substances. Thus Meselson's deletion of these negatives from the samples biases the percentage of positives upwards.

Among the positives, the collaborating laboratories were in agreement that three of the samples were clearly positives at 20 pptr or greater. There were six other samples about which there was some agreement, but these were too close to the limit of detection to provide precise quantitative determination. That is, they were too low to be declared as definitive positives according to the rules of evidence agreed upon by the collaborators. Under the circumstances, Meselson's selection of data so as to include the unconfirmed positives, and so as to delete the confirmed negatives, is untenable.

It seems to us illogical to conclude that one-third of the samples were positive; one-twentieth appears a more supportable figure, with all positive observations having come from an area in Missouri near sites where TCDD-containing wastes have been used for dust abatement.

Finally, the determinations in livers were all negative, with the exception of one "maybe." This sample was not taken from any of the animals with positive fat determinations. Since beef cattle appear to accumulate TCDD in both liver and fat, the inconsistency of the liver and fat samples creates questions about the validity of analysis of all the samples, and surely those below 20 pptr.

If it is confirmed that TCDD was indeed in the beef animals, the implication of 2,4,5-T as the source must be established as distinct from the far greater potential exposure to TCDD from other products derived from trichlorophenol, particularly in the Missouri sampling area. Without both validation of findings and identification of the source, these data are not very useful for evaluating the potential TCDD hazards from 2,4,5-T, especially as it relates to forest spraying.

Meselson made reference to the finding of TCDD in human milk and wildlife in his report of January 10, 1978, to the EPA under contract 68-01-1951. In that report, and in his presentation of February 21, he described human milk determinations showing four positive samples from Texas and Oregon, all of which were either at the limit of detection or within a few tenths of a part per trillion of it. He also described a consistent positive analytical bias of about 0.3 pptr in determinations at that low level. If adjusted for that bias, all but one of the samples would have become "non-detectable"; the fourth sample would have had both positive and non-detectable readings in the several runs.

Among the wildlife samples, it is our understanding that the minimum quality standard for analytical recovery was a minimum of 50 percent recovery. Among the 11 wildlife samples analyzed by Meselson, only four approached or surpassed the minimum recovery criteria, of which one deer mouse was analyzed at 46-48 pptr, one was a shrew at 16-20 pptr, and the others were either not detectable or 9-10 pptr.

It is our understanding that the 11 samples analyzed by Meselson in this report were taken from a group of over 100 wildlife samples, of which 81 were furnished from Pacific Northwest forests. The results of these samples were reported to the U.S. Forest Service by the EPA.[1/] In short, of the 81 samples, eight gave readings suggesting that some TCDD might be present. Of these, only two had sufficiently high analytical recovery to make them more than suggestive of the presence of TCDD, and only one could be regarded as quantitative. We do not feel that such a small percentage of positives in wildlife at such low levels constitutes a threat of chronic exposure.

1/ Letter from Douglas Costle to John McGuire, Chief, U.S. Forest Service, October 19, 1977.

In summary, the data bases on which Meselson and Streisinger cast doubt on the safety of the use of 2,4,5-T do not appear to these scientists to give adequate support either to their assumptions or to their conclusions. Indeed, they provide reassurance that forest herbicides do not lead to chronic exposure to harmful levels of TCDD.

The reason for this rather specific critique of the comments of these two scientists needs to be made clear. First of all, risk assessment is difficult under the best of circumstances when all data are taken at face value. Secondly, the presence of a pollutant in a living animal or a small percentage of animals does not in itself indicate either hazard or the necessity for abolition of that pollutant. Indeed, exposure to environmental chemicals is commonly followed by the transitory presence of those substances in the exposed biota without apparent detriment. Detection of a chemical alone does not contraindicate use; even chronic exposures are tolerable at no-effect levels. Detection of transitory exposures is even less alarming when evidence of harm is lacking. Thirdly, to overstate the risk of one alternative in forest management could stampede public opinion into a decision to turn to substitutes of less utility which also frequently have substantial and measurable hazard. Finally, the choice of weak or selected scientific evidence in making recommendations for forest policy would undercut the entire documented technical information base on which the management of the Nation's forests depends.

COMMENTS SUBMITTED BY GEORGE STREISINGER

Dr. Newton in the course of his discussion stated that the toxic fat used in Allen's experiments with monkeys contained no TCDD. He thus contested the relevance of Dr. Allen's experiments and the conclusions presented by Dr. Meselson and also by me, earlier during this symposium, regarding the additivity of harm caused by TCDD.

Dr. Newton's allegations are incorrent. Tetrachlorodioxin has been shown to be present in the sample of toxic fat used by Allen, and the analytical results concerning this sample were published several years ago (Flick, D.F., D. Firestone, J. Ress, and J. R. Allen, 1973. Poultry Science 52, 1637-1641). More recently the sample was reanalyzed by Baughman and Meselson (personal communication) who confirmed the earlier findings of appreciable levels of TCDD in the toxic fat.

COMMENTS SUBMITTED BY HAROLD L. OLINGER

A statement by Dr. Gunter Zweig, EPA, needs clarification about the way in which herbicides are used in forestry. Previous testimony indicated that the contaminant TCDD undergoes photo-decomposition in

ultra-violet light. Half-life estimates ranged from several hours to several days depending on the amount of light, temperature, etc. Dr. Zweig commented that this would not be important since the chemical would be in the shade.

Forestry use of the phenoxy herbicides is primarily for site preparation and release. Several symposium speakers substantiated this fact. In both of these uses, most of the tall trees have been harvested or killed. The herbicides are sprayed onto the canopy of the low brush and sprouts which are then present on the area. There is very little shade in such areas, and it would seem to me that the microscopic film of chemical deposited on the leaves would be very strongly subjected to ultra-violet light. This would probably also be true in right-of-way and rangeland work.

The toxicology and fate of TCDD in the environment must be determined. Until such data are available, however, decisions about the phenoxy herbicides must be made on the basis of the factual data available on the way that herbicides are being used. Forestry uses of herbicides, under existing label restrictions and with constantly improving technology to reduce the risk of non-target damage, present very little danger that TCDD will enter the human food chain.

COMMENTS SUBMITTED BY MARGUERITE L. LENG

Kent Shifferd, Coalition for Economic Alternatives, referred to a Florida study in which 2,4,5-T and silvex were found in a high percentage of human urine specimens. This study by Dougherty and Piotrowska was reported in Proceedings of the National Academy of Sciences, USA, Vol. 73, No. 6, 1777-1781, June 1976. It utilized a screening method in which extracts of urine from university students were examined by mass spectrometry without cleanup. Among the "possible structures" detected were 2,4,5-T and silvex, but these were not confirmed by an independent method and no values were assigned to the levels claimed to have been found. Thus, there are no data to be cited as evidence of widespread contamination with these herbicides.

Frederick Kutz, Acting Chief of EPA's Ecological Monitoring Branch, presented data for a non-specified number of samples of human urine and water. Significant residues of trichlorophenol and pentachlorophenol were found, but neither of these are herbicides used in forestry. None of the samples of water contained detectable silvex, and only 0.04 and 0.36 percent were positive for 2,4-D and 2,4,5-T, respectively, with a mean of less than 0.1 part per billion and a maximum of less than 2 ppb. Only "traces" of 2,4-D or 2,4,5-T were detected in human urine (0 percent positive) and only 0.2 percent of the samples contained measurable levels of silvex, with a reported maximum of 3.2 parts per billion. Although up to 32.4 ppb trichlorophenol was found in 1.7 percent of the urine samples, experiments by

Dow have demonstrated that 2,4,5-T and silvex are not readily metabolized to trichlorophenol in nonruminants, and the ether link in silvex is not readily cleaved even in ruminants. (See M. L. Leng, Comparative Metabolism of Phenoxy Herbicides in Animals, in Fate of Pesticides in Large Animals, edited by G. W. Ivie and W. H. Dorough, Academic Press, New York, 1977.) Up to 193 ppb pentachlorophenol was found in 84.8 percent of the samples, possibly as a metabolite of hexachlorobenzene (D. E. Clark, USDA, Texas A&M University). Thus, the cited data do not reveal exposure of the general population to 2,4-D, 2,4,5-T, and silvex, nor even to pentachlorophenol, although the abstract at the symposium appeared to indicate that it did.

Matthew Meselson of Harvard commented that EPA had misrepresented the findings in their monitoring study for TCDD residues in beef and fat and liver. He claimed that at least 30 percent of the fat samples from treated areas were positive by including those that may have contained 5 to 10 ppt TCDD (below the validated sensitivity of the method) and the three samples which had measurable levels of 20, 20, and 60 ppt. It should be noted that the 60 ppt and one 20 ppt value were for samples from one farm in Missouri where the residues could have been due to use of contaminated waste oil for dust control on dirt roads, rather than to treatment of pastures with 2,4,5-T. He is to be commended for admitting that the "positive" values in his study on mother's milk were not statistically significant. However, this does not allay the fear generated by page-one headlines a year ago proclaiming that TCDD had been found in four samples of mother's milk from Texas and Oregon.

George Streisinger of the University of Oregon extrapolated Meselson's data for selected beef fat samples to indicate that all beef fat could contain 10 ppt TCDD and that eating 400 meals of beef containing 10 percent fat would be enough to expect an effect in humans. This is highly unlikely, since only a small fraction of the country's rangeland is treated with 2,4,5-T in any one year, and most cattle are withdrawn from treated areas for several weeks prior to slaughter. Another factor is that 2,4,5-T is applied in the spring and range cattle are generally not taken to market until fall. During this time residues of 2,4,5-T and TCDD in or on treated foliage would have decreased to much lower levels than in the beef study conducted by EPA in 1975. Thus, there is little likelihood that significant levels of TCDD would be present in the human diet at any time. Furthermore, there is ample evidence that TCDD is not totally assimilated nor completely retained in the body. Thus chances of bio-accumulating toxic levels of TCDD are infinitesimally low from a practical point of view.

Stephen Hager of the Citizens Against Toxic Sprays cited a study by Stehl and Lamparski of Dow (Science 197, 1008-1009, September 2, 1977) as evidence that burning an area treated with 2,4,5-T containing 0.1 ppm TCDD would result in a level of 1.6 ppm TCDD. This extrapolation

from a laboratory burning study is not warranted since it was done on grass collected immediately after treatment with 2,4,5-T at six times the maximum rate recommended for brush control in pastures. In that study, 0.00016 percent of the 2,4,5-T in or on the grass was converted to TCDD by burning in a closed system, in contrast to allegations that 15 percent conversion might occur. Treated forest areas might be burned for site preparation but not for release of conifer seedlings. In any case, burning would be delayed for several months after spraying to permit the treated trees to become dry enough to burn easily. By that time, the 2,4,5-T residue would have decreased to very low levels. For example, in a study in Texas less than 1 ppm 2,4,5-T remained in sprayed live oak at 6 months after treatment (Baur et al., Weed Science 17, 567-570, 1969). Thus, only insignificant amounts of TCDD might be formed by burning wood from treated brush in forests. Furthermore, the traces of TCDD formed would be carried away in the hot air generated by the burning and would not remain in the ashes. The TCDD would also not be ingested by livestock since grazing would be deferred to permit establishment of new forage growth in burned areas.

Philip Kearney, Chief of USDA's Pesticide Degradation Laboratory, commented only briefly on their recent studies with silvex in a mini-ecosystem containing grass, soil, water, and air (Nash and Beall, presented at the 1968 spring meeting of the American Chemical Society in Anaheim, California). Three consecutive treatments were applied using an emulsifiable concentrate at 2 kg/ha and a granular formulation containing 2,4-D and fertilizer such as used on lawns. Both formulations contained 0.044 ppm TCDD for the first two treatments but were spiked at 7.5 ppm for the third application to provide higher residues of TCDD for a dissipation study. Residues in or on grass decreased rapidly from 9 parts per trillion at the time of spray application to 0.5 ppt 28 days later (half-life 7.5 days). Residual TCDD was held primarily in the thatch and the soil surface, particularly from the granular treatment. The top 2 cm of soil contained about 0.1 part per trillion TCDD after two spray treatments and 0.3 ppt after two applications of granules 35 days apart. Little or no decrease in soil residues was noted during this relatively short study, probably due to continued contamination by washoff of TCDD from the grass and thatch when the turf was sprinkled. Leachate water contained extremely low levels of TCDD (0.0001 part per trillion) from both the spray application and the granular treatment. Residues in the air above the treated grass were significant only on the day of application of the emulsifiable concentrate and decreased at about 1 femtogram (10^{-15} gram) per cubic meter within 2 weeks after treatment (half-life about 8 days). Subsequently, an outdoor study was conducted using the emulsifiable concentrate spiked with 15 ppm TCDD. This demonstrated that dechlorination of the TCDD occurred when sprayed foliage was exposed to sunlight, as reported previously by Crosby and Wong (Science 195, 1337-1338, 1977). Residues of TCDD

in air were also partly degraded as shown by consistently lower values by GLC analysis than by measuring total extracted tritium-labeled compounds. Thus, the rate of dissipation of TCDD due to sunlight in the field would be even faster than the half-lives found in these ecosystem studies where light was filtered through greenhouse glass.

COMMENTS SUBMITTED BY T. H. SILKER

Lawrence and Walstad adequately pointed out in their introduction that their comments on use of herbicides in forestry would cover silvicultural alternatives available to both the Douglas-fir region and the South. Some closing statements, however, seem to be directed primarily to evaluations within the Douglas-fir region. In this manner they appear to play down the applicability, effectiveness, and economic potential of some alternative tools in the East, and especially in the South:

Vegetation Management Alternatives

(a) "Prescribed burning is used to dispose of residual brush and slash left after the previous harvest operation."

(b) "Of the techniques now available, chemical herbicides are the most versatile. These materials will effectively suppress a broad array of competing species with considerably more finesse than other alternatives."

Summary

"Of the various tools available for accomplishing these tasks, the use of herbicides such as 2,4,5-T has proven to be one of the safest and most cost-effective approaches to vegetation management."

The quoted views are considered adequate for the Douglas-fir region. However, statement (a) does not cover prescribed burning as a preventative or preparatory tool. Southern silviculture uses it for: (1) hazard or rough reduction, (2) to control undesirable understory competition before conifer regeneration cutting, (3) to prepare sub-climax conifer seedbeds, (4) to control "brown-spot" disease on longleaf pine seedlings and saplings, or (5) site clean-up after harvesting. The tool is adequate, with given fuels and techniques, to meet the objectives above. Moreover, prescribed burning cumulative treatments can usually be effected with less cost per rotation than herbicide treatments. When used early in stand history, they also prevent or reduce alternative use of herbicides.

Cost-effectiveness appraisals are increasing and will accelerate as energy-capital outlay investments increase. Prescribed burning for uses (1) through (4) has been substantial since 1954 and could be expanded to assist sub-climax conifer management in the Northeast, Lake States, and other regions. My experience indicates the strongest deterrents limiting use are: (1) unfamiliarity with ecological relationships and the tool as a safe and effective prescription and (2) reluctance to gain first-hand experience.

COMMENTS SUBMITTED BY JAMES A. YOUNG

Comments on paper "Range Vegetation Management with Herbicides and Alternative Methods: An Overview and Perspective" by Dr. Charles J. Scifres.

Dr. Scifres has done his usual good job of discussing and providing a perspective for the use of herbicide and/or alternative methods for management of rangeland vegetation. My comments mainly concern the extension of Dr. Scifres discussion to include the management of sagebrush/grasslands which are an important vegetation type of lands administered by the U.S. Forest Service in the Western United States.

1. Historical Perspective

Even though the time scale for the history of grazing sagebrush/grasslands in Western North America is extremely short (slightly more than a century), the changes that have occurred are monumental. In slightly more than a century the sagebrush/grasslands have known three stand renewal processes:

a. Pristine with virtually no large herbivores, recurring wildfires, and insect defoliation.

b. Unlimited grazing and promiscuous burning.

c. Attempted exclusion of fire, alien plant introduction, and attempts for grazing management.

The net result is we now have an ecosystem that never has existed before and will not be the same tomorrow.

2. Reaction to Grazing

The landscape characterizing species of sagebrush (*Artemisia*) are not preferred by domestic livestock. The essential oil content of big sagebrush herbage inhibits the activity of rumen microorganisms except for the native pronghorn. Past excessive grazing in sagebrush/grasslands has resulted in the reduction in herbaceous

vegetation and an increase in shrubs. The life span of the dominant shrubs is sufficient to close the site to establishment of perennial forage species for the foreseeable future.

3. Alien Introduction

The accidental introduction of a host of alien herbaceous plant species to the sagebrush/grassland has irrevocably changed the ecology of these communities. Lower stages of secondary succession are completely preempted by the alien plants. The alien dominants of higher seral stages persist in native plant communities in equilibrium with their environment. Dominance of alien species such as downy brome render these degraded communities highly flammable with each recurring fire degrading these communities further.

4. Dynamic Vegetation

We cannot stop population dynamics and preserve sagebrush/grassland communities in their current condition. We have the choice of continued degradation toward dominance by brush and alien herbaceous annuals or, through the application of appropriate technology, improvement in condition toward an equilibrium with the potential of the environment. The mechanism of degradation is triggered by recurring wildfires. Man is the main cause of wildfires and the use of sagebrush/grasslands by humans can only increase in the future.

5. Multiple Use

Fortunately the most desired plant community for almost all uses of sagebrush/grasslands is a stable mixture of shrubs, forbs, and grasses. This generally reflects what existed under pristine conditions so, as Dr. Scifres suggested for Texas shrub/grasslands, departure from equilibrium conditions provides a yardstick for measuring environmental quality.

6. Appropriate Technology

Attainment of the goal of a stable perennial forage- and browse-dominated plant community can only be attained through the use of appropriate technology. Safe, economical treatments including herbicides have been developed and extensively tested which permit the establishment of seedlings of desirable perennials in degraded sagebrush/grasslands. The nature of the resource limits the effectiveness of alternatives to herbicides:

a. Fire triggers cycles of degradation in sagebrush/grasslands. Once sagebrush/grasslands are restored to a stable mixture of shrubs, forbs, and grasses, prescribed burning may play an important role in maintaining the balance among species.

b. Mechanical alternatives are limited to specific portions of the sagebrush/grasslands that have soil and topography that permit use of tractors. Mechanical methods are often more expensive and more destructive to some portions of the environment, such as archeologic values, than herbicidal methods.

7. Management

Once a balance between plant communities and their environments is restored to the sagebrush/grassland ecosystem through application of appropriate technology, proper and judicious grazing management of livestock, game and other wild animals, and free-roaming horses is absolutely necessary to maintain the environmental quality that we all desire.

Epilogue

Several points concerning rangelands were raised during the meeting that are very important and deserve specific comments:

1. Use of Herbicides on Rangelands by Public Land Management Agencies

a. Obviously from Dr. Thomas Nelson's presentation, the U.S. Forest Service uses very little herbicide on rangelands, although the U.S. Forest Service has a policy and methodology (admittedly complex) that permit the use of herbicides. In contrast, the Bureau of Land Management of the U.S. Department of the Interior has completely abandoned herbicides. The important point is that no viable alternative has been offered or is in practice to solve the vegetation management problems for which herbicides were being used. Because of the land ownership patterns in many Western States where the vast majority of the rangelands are federally controlled, decisions to suddenly stop range improvement practices can have a disastrous impact on the livestock, industry, local economics, and eventually the entire red meat production in the United States. We have stressed that rangeland communities do not stand still forever. If an effort is not made to improve these communities, then by default continued environment degradation is the only alternative.

b. The separate pesticide registration program of the Department of the Interior supercedes and makes non-viable all of the cooperative efforts between USDA and EPA to establish the benefits and safety of pesticides.

2. Labor-Intensive Pest Management

We have experiments underway that compare mechanical, herbicidal, labor-intensive, and no-action manipulations of juniper

woodlands. These experiments were designed before we knew that labor-intensive methods were favored by environmentalists, so we can assure their objectivity.

3. Integrated Pest Management

It is difficult to initiate integrated pest management programs when the most valuable tools for pest management are eliminated by regulation. Without herbicides, integrated pest management on sagebrush/rangelands is difficult to visualize.

4. Range Livestock Industry

The obvious lack of interest by the public land management agencies toward range improvement makes range management improvement on private lands vital to the survival of the industry. It is important to note that livestock producers from the western range States were not present at this symposium when the interpretation and application of the results of the symposium may influence their very survival as an industry.

COMMENTS SUBMITTED BY HYLAND R. JOHNS

I quote directly from "Right-of-Way Vegetation Management--An Evaluation of Techniques and Alternatives" by W. A. Neiring and respond accordingly:

(Quotation from Niering) "The Forest Service should carry out and require utilities to employ only selective techniques on rights-of-way on federally owned lands."

Comment: If "selective" includes selective stem foliage, semi-basal oil-water, and other recognized selective techniques and formulations, such would be acceptable. However, no treatments should be required or prescribed without a full inventory and assessment of right-of-way resources, problems, and sensitive areas.

(Quotation) "EPA should set guidelines on the sound management of this extensive land resource involving millions of acres of public and private lands."

Comment: It was not the intent of Congress that EPA should set guidelines of this sort, which is shown by the legislative history of FIFRA. Such guidelines have been required by the Forest Service and are generally being monitored closely for full compliance by their personnel.

(Quotation) "Aerial use of herbicides is not advocated as an initial vegetation technique on rights-of-way."

Comment: On the contrary, under some conditions such as remote, inaccessible terrain and tall, dense undesirable vegetation, aerial would be the safest environmentally, the most cost-effective, and also the least hazardous technique to workers and the general public. By contrast, the selective basal oil technique may cause more damage to desirable understory ground cover than aerial application on the dense overstory. This is because 5000 to 10,000 stems or more per acre require a large quantity of oil per acre, thus damaging ground cover--to say nothing of the oil shortage.

(Quotation) "New formulations of 2,4-D derivatives. . . effective on woody species may provide an effective substitute for 2,4,5-T."

Comment: To date, no effective substitute for 2,4,5-T has shown acceptable results for many right-of-way conditions. In fact, the use of substitutes may require higher concentrations, greater quantities, and more frequent applications at greater cost and more environmental disturbance than proper use of 2,4,5-T following label directions.

There has been considerable information published concerning the safety of herbicides with regard to wildlife, livestock, and humans. These treatments are safe when used as directed and, in fact, are far safer to applicators than sharp power tools and dangerous equipment, including axes, brush saws, power saws, etc. While our corporate accident records are confidental, every State publishes worker occupational safety data substantiating the favorable safety record of chemical crews when compared to the more dangerous tree and brush-cutting crews. Three States selected at random are typical of this trend nationwide and are more representative than just one company's experience:

State "Manual" Worker Compensation Rates

State	Brush Crew	Chemical Crew
Virginia	8.41	1.56
New York	14.89	2.80
Louisiana	15.62	2.10

Typical Comparative Costs/Acre

Method	Minimum	Maximum	Variables
Hand cutting	$150	$1000 (or more)	Brush disposal method
Machine cutting	25	250	Terrain limitations
Herbicide	75	175	Brush height, density, terrain

The above costs for single treatments; at least two treatments would normally be required in a 10-year period. Costs quoted by Niering for one local utility are not representative of the Northeast, nor of other parts of the United States. Labor rates, growing conditions, terrain, sensitive areas, and other variable factors would modify typical figures shown here. In summary, total programming requires an inventory and analysis, identifying and evaluating right-of-way resources, objectives, and other important considerations, not just one particular technique to meet all conditions. Certified commercial contractors have all manual, mechanical, and chemical methods from which to select to achieve long-term vegetation management most beneficial to all concerned.

COMMENTS SUBMITTED BY JEFFREY A. DAVIS

Dr. Niering's paper gives a good overview of techniques and alternatives in this field. Here, I would like to focus on the distinction between "brush control" and "vegetation management" as these concepts apply to right-of-way maintenance. Once the basic differences are understood, the role of herbicides as a vegetation management tool should be less controversial.

Brush Control.--This is our legacy. It has been the overwhelmingly dominant practice for decades beginning with the first overhead electric lines. It is a simplistic concept requiring little or no knowledge of vegetation. The main idea is simply to keep the tall brush from growing into the conductors, and to do the job at minimal expense--but with no thought to future costs. Today brush control has moved from widespread, indiscriminate stem-foliar spraying to more selective spraying. Generally, more thought is now given as to what types of vegetation are treated and to treatment methodology. In other words, some utility companies have changed for the better; others are "dragging their feet."

Vegetation Management.--This is a more sophisticated concept, but it has far more potential for fully realizing the goals of right-of-way management. Right-of-way vegetation management is both an art and a science. Also, in contrast to brush control, it recognizes a multiplicity of values. It has as its goals the following:

Maintenance of line security and reliability
With minimum adverse impact
At the lowest cost
For the most years
With the highest conservation values.

Although this set of goals and values was first articulated by Egler, it is now generally adopted by most utilities and agencies. But to

truly meet these goals, some knowledge is required. We need to know for a given right-of-way:

What the vegetation was
What the vegetation is
What the vegetation could be (under various management alternatives)
What the vegetation values are.

In other words, you cannot really determine if or how well you are meeting your goals unless you have a full understanding of vegetation differences and possibilities. Remember, vegetation management is ecological (that means scientific); and, therefore, it requires something more than mere speculation or wishful thinking about what is "minimum" impact or "lowest" long-term cost, or "highest" conservation value. It requires knowledge, interpretations, and evaluations that will stand up "in court" under scrutiny and analysis. Once these considerations are reasonably fulfilled, however, then it is possible to say that one is practicing right-of-way vegetation management.

Are these conditions being fulfilled in contemporary utility programs? Not to my knowledge. To call present day right-of-way maintenance "vegetation management" is a misnomer. The companies are adequately dedicated to maintaining line security but with regard to the rest of it (i.e., lowest cost, for the most years, with the highest conservation values)--mainly lip service. That is the state-of-the-art!

Vegetation management is a long-term proposition, an investment in the future. But it is no overnight panacea, something which most utility and chemical people seem to be looking for. Development of sound vegetation management will require a modest investment in research and development, perhaps a larger investment in information and education. Because it involves more than does brush control, it must be gradually phased-in to utility operations.

Many utilities are resistant to the idea of vegetation management as defined here. However, the main barriers to the adoption of the concept are, in my opinion, psychological and sociological. They are not economic (utilities claim that the "overhead" costs are excessive), nor is it due to lack of scientific information. Vegetation management is a hard idea to sell to someone who is ill-trained to deal with it, or who is apathetic to vegetation values.

Thus I am forced to conclude, in this year of 1978, that except for a few well-scattered exceptions, we are still in the era of brush control. Although right-of-way maintenance work today is more selective and is doing less damage, it is still brush control. Whether or not the industry has the will and foresight to commit itself to the ecologically, economically, and socially superior concept of right-of-way vegetation management remains to be seen. Government regulations cannot force a genuine change in attitude. This comes only from within.

What about these attitudes? At some risk of overstepping my charge as a government bureaucrat and Vegetation Management Specialist, I would like to comment briefly about this broader aspect of right-of-way management and land management in general. This is what happens when I put on my "concerned" ecologist's" hat and take my role seriously. For a while I feared that this burden might fall solely on my shoulders, but thanks to Kent Shifferd and Stevens Van Strum, the load has been lightened some.

I for one believe that the ecological crisis is for real, even though our technology in the U.S.A. still insulates us from reality. In the final analysis, at some future time after many trials and tribulations, it will become evident that solutions to the intertwined sociologic-economic-ecologic problems of land resource management will NOT come from improvements in herbicide chemistry, nor from technological advances, nor from more sophisticated and intensive management systems to meet "growing demands," even these are the hopes and projections of the university-government-industrial establishment so well represented at this symposium. BUT, solutions to our dilemma will be found in our values and attitudes as they relate to life and nature. The problem is ethical or, in the words of Wendell Berry, "The ecological crisis is a Crisis of Character and of Culture."

Traits that must be re-established in our individual lives, in our communities, and in society at large include: a sense of humility toward nature (as opposed to arrogance), restraint, devotion to household and community, intelligent and nurturing use of the land, more self-reliance, restraint, a new attitude about work and muscle power (our bodies would surely benefit), a true commitment to conservation. Berry explores these and other aspects of our character crisis and links them all into a holistic view of the problem in his profound book, The Unsettling of America: Culture and Agriculture, 1977, The Sierra Club, San Francisco, 228 pp.

So with this little lecture I have said nothing more (or new) than that we must seriously search for alternatives to our current addiction to more advanced technology and growth. Hopefully the next symposium will come to grips with the paramount issues in land management.

COMMENTS SUBMITTED BY DANIEL V. CASSIDY

Right-of-Way Vegetation Management on California Roadsides

The California Department of Transportation is a large user of herbicides, used in the maintence of over 225,000 acres of roadsides. It is our policy to use alternatives to chemical controls whenever possible and to use only the safest possible herbicides. The use of

2,4,5-T has been prohibited on roadsides in California for a number of years. It is this Department's policy to retain as much native vegetation on roadsides as is compatible with the surrounding environment. Unlike the other State reports given at this meeting, trees on California roadsides are only removed for specific reasons and herbicides are not used for tree removal. Soil-acting herbicides are used on most of California roadsides to provide an area free of vegetation next to the pavement to help prevent fires from starting on highways. Criteria for selection of herbicides used on highway rights-of-way are in order of importance: 1. Safety, 2. Performance, 3. Economy. Burning of roadside vegetation is done in a very limited way and is limited to rural areas, such as ditches, where no other practical method of removal of standing vegetation is satisfactory.

Brush and tree seedlings are cleared to a distance of about 10 feet from the edge of the pavement, either by hand or with a brush mower. Thereafter, new growth may be destroyed by herbicide usage. In general, herbicides are used only if growth is less than 1-1/2 feet high.

The California Department of Transportation does sponsor a number of research projects with the intent of reducing pesticides usage. Three projects are now underway with USDA, Agricultural Research Service, Albany, California. These projects are biological control of Russian thistle, yellow star thistle, and field bindweed. The benefits of these research projects will go far beyond the limits of highway rights-of-way. Public agencies cannot expect private industry to invest in biological control of weeds. The potential social and monetary value to the public is high; the private value of the research to any firm is low or nonexistent.

AQUATIC USES OF HERBICIDES AND PROBLEMS ASSOCIATED WITH FORESTRY AND WATER RESOURCE MANAGEMENT

Charles R. Walker

During the past 25 years, I have been involved in research on aquatic weed control and data generation and registration of these pesticides with the Environmental Protection Agency and numerous interagency committees concerned with integrated pest management. Specifically, the work with the USDA-USDI Joint Weed Committee and the Program Review Panel for the Federal Working Group on Pest Management has focused attention on many problems associated with forestry and water resource management. I have been asked to address the aquatic weed control practices involving use of herbicides at this symposium.

First of all, we must recognize that aquatic plant life not only delineates many important features of water quality but also the distribution, reproduction, and survival of fish and wildlife. Thus, it

seems to me that there are many questions that must be answered regarding the use of herbicides before satisfactory management plans can be formulated to assure protection of these fish and wildlife resources.

Can we manage environmental factors that affect the growth of different species of plants, and can we control the species composition of these plant communities without producing adverse environmental effects? Fishery biologists talk of the need to control certain plants to promote the growth, vigor, and fecundity of fish and their food organisms in order to assure sustained yields to the fisherman. On the other hand, wildlife biologists say some of these same species of plants that are considered to be adverse habitat to fish are among the favored foods of waterfowl. What role does aquatic vegetation have in channeling nutrients and energy? How can we manage plant life for controlling important water quality constituents which sustain a healthy fish and wildlife habitat? In turn, how will this habitat be managed in a manner compatible with all the many conflicting uses for water? What are the long-term ecological effects of herbicides?

In scanning your program, I was delighted to see that alternative approaches are being sought in forestry management. However, I was concerned as to precisely what you perceive as an integrated plan for managing the pest species. Is the use of a chemical herbicide compatible with the biological control methods? How do mechanical methods and other physical techniques such as water level fluctuation fit into the use of chemical or biological methods for managing aquatic plant life? As a matter of fact, I am also concerned with what one might call an undesirable plant or weed. How do we recognize what is desirable from an undesirable feature of plant life that would allow the cultivation of the best water chemistry?--the best production of fish food organisms?--the best habitat for fish or wildlife?--and ultimately the enhancement of its aesthetic quality or recreational uses?

As I understand aquatic weed control efforts in the past, aren't there two rather important biological concepts currently absent from the management plan for problem plants? The first of these is that nature abhors a vacuum--that is whenever a void exists or in ecological terms, "a niche," then a plant species will quickly occupy that particular body of water or area within a body of water. Doesn't this conflict with the concept that we must control all aquatic plant life? Hasn't the use of herbicides been to erradicate vegetation or create a water body devoid of plant life? This concept leaves me somewhat mystified as to what role aquatic plant management plays in the manipulation of ecological succession or the cultivation of replacement species of vegetation. Aquatic plant management must consider the manipulation or guidance of an ecological succession of plants that are the most acceptable to man's concepts of use of that environment. Emphasis should be given to those species that benefit fish and wildlife. In my judgment, these concerns must be addressed if we are to assume that this is a proper consideration of conservation of aquatic

resources. My second point requires that we compare to to agricultural practices or manipulation of plants. From the standpoint of the wildlife management biologist, we must create what we call the "edge effect" or "ecotone" for good wildlife habitat. This suggests that we are cultivating certain species of plants in a physical relationship to the land mass that we are attempting to manage for the purposes of enhancement of wildlife habitat. Wildlife biologists have long recognized the requirements for an interspersion of different plant forms that are necessary for nesting, feeding, and escape from predators. What concepts in aquatic plant manipulation exist for the development of the proper edge effect? What species of aquatic plant life should we cultivate in aquatic habitat for the purposes of enhancing desirable fish food organisms?--spawning areas for game fish species?--or balancing escape habitat to assure accessibility to predator fish to their prey but at the same time preventing overpopulation?--and what type of cover enhances sport fishing? When we talk about weed control and waterfowl habitat, shouldn't we also consider the possibility that certain aquatic plant species be cultivated? Shouldn't we assure a ready food supply to migratory waterfowl in those areas where nesting and rearing take place? These young birds require a high protein intake, and we must provide habitat for the necessary invertebrate forms that comprise food of these nestlings. All in all, there appears to be a necessity for understanding ecological succession and the manipulation and cultivation of desirable plant species. I would trust that attention might be given to these problems as discussion proceeds in the conference deliberations.

Unfortunately, many of the Department's uses of these herbicides are considered by industry as minor uses. Because they are applied to small acreages or in minute amounts, there is little profit incentive by the industry to undertake the costs of registration or re-registration of these uses. We appreciate that registration costs are high and the economic incentive by private industry is often lacking regardless of the merits of the compound. In addition, there is often an aesthetic stigma attached to chemicals that are used in the water. Many private companies would prefer to avoid the adverse publicity by refusing to register or supply the needed compounds. The herbicides used by the Department involve the enhancement of wildlife habit and aesthetics, protection of forest and crop lands, irrigation projects, and specifically in the control of aquatic vegetation in fish hatcheries, public fishing areas, and on waterfowl refuges. Algicides and other related biocides may also be required in specific instances where their use will permit the harvest of fish or the protection of fish from adverse environmental effects. I am aware of many instances where excessive vegetation causes winter-kill in some of our shallower lakes.

Many of the materials that we use have highly restricted labels and are used only by trained specialists. However, we also recognize that the label use directions for others are rather generalized and are

not adequately formulated for aquatic use. Another problem is associated with the proper identification of the target species and the safety with which they can be applied in the presence of desirable non-target organisms.

While we are sympathetic with the difficulties that plague the Environmental Protection Agency in administering the new Federal Environmental Pesticide Control Act, we must expedite the gathering of information required for registration of aquatic herbicides. We would also like to see a streamlined review procedure established for re-registration of these aquatic herbicides. This applies particularly to those minor use products where patents have expired. Priority must be assigned to those herbicides used by State and Federal agencies. In the best public interest and without the sacrifice of environmental safety, perhaps State registration may appear to be a solution for the specialized uses of some aquatic herbicides and algicides. However, the safety requirements and precautionary labeling must assure protection of fish and wildlife and should be consistent and not at variance from the Environmental Protection Agency's criteria for safety. Since many waters are interstate in nature, the placement of herbicides and algicides in these waters directly may also constitute a water quality problem. Thus, these uses should also be consistent with the Federal Water Pollution Control Act relative to undesirable pesticide residues in water, fish, sediments, or other components of the ecosystem.

I am also impressed with the necessity of controlling nutrients as a major tool in eliminating excessive growths of certain types of vegetation. Section 208 of areawide planning and pollution abatement strategies directly relates to the needs in or even requirements for aquatic plant management. I hope you can focus attention to this in your session on environmental utilization of aquatic plants. The specialist in aquatic plant management certainly will become better recognized professionally when he is paid to utilize these plants for animal feeds and for treatment of domestic waste or as pollution abatement tools. As a Department, I see our role as a major resource management agency concerned with improvement of the aquatic habitat for fish and wildlife and aesthetic values associated with its utilization by the public. Certain agencies such as the Fish and Wildlife Service and Bureau of Reclamation have a vested interest in this problem and should find better and safer means of manipulating and managing aquatic plants. Thus we need a team approach for generating toxicology and residue information necessary for EPA registration of chemicals used for control of aquatic vegetation. We have limited our research to a few herbicides used by the Department. We must continue to emphasize studies concerned with safety to fish and wildlife and particularly those persistent chemicals with hazardous residues that biomagnify in food chains.

At this point, I would like to touch upon a rather sensitive subject. While we advocate an integrated approach to aquatic plant management, we must admit that we have taken a very cautious and conservative approach on the use of biological control methods. Our scientists have advised me that the arbitrary introduction of fish and other macroorganisms into the environment for control of aquatic vegetation can cause many problems. They are concerned that inadequate quarantine procedures and investigations on non-target species will result in the ill-advised introduction of some undesirable exotics that could escape into other ecosystems or possibly transmit their parasites and diseases to native species. One of the major research efforts of the Fish and Wildlife Service has been to discover and develop methods to control such exotics as the carp, the parasitic sea lamprey, and a variety of fish diseases. They have also worked cooperatively with the Corps of Engineers, private industry, and several State agencies in the development of sterilized grass carp or the white amur that has been used for the control of submersed aquatic vegetation.

However, just as we are concerned with chemical residues, we must also give particular attentuon to "biological" types of residue problems. Can this residue, represented by exotic species of life, not only persist in the aquatic environment but may also multiply, migrate upstream or downstream, or even be transported into other watersheds? Can the effects of biological control agents be confined to the target species in a specific area or location? Can it achieve a timely rate of control and provide the uniformity of effectiveness or usefulness under a variety of environmental conditions? What about the competitive displacement of native species by bio-control agents. Is this a problem of serious dimension to fish and game species when food supplies are diminished and the quality of their environment is degraded? Can we ensure that certain weeds may not dominate the succession of plant life and so modify the conditions that only tolerant fish and wildlife species or their foods may exist? Have we given adequate consideration to those geographic areas or habitats that involve endangered species? Before we employ a biological control agent, we must be thoroughly familiar with its relationship to other organisms in the ecosystem. We must know we can control where it will be placed and have to be able to limit its distribution, rate of growth, reproduction, and longevity. We should always ask--will the control agent affect the ecological succession of plant life and bring more resistant and perhaps noxious species into dominant ecological position? Thus, biological control by itself may not be a panacea or cure-all and a bio-control agent may not eliminate or reduce the target species to an acceptable level throughout the area without serious consequences to itself in the process. Moreover, biological control agents are rarely adapted to a wide range of physical and chemical conditions and may have serious limitations relative to water quality, hydrological character, etc.

Many fishery scientists and pollution biologists are concerned about the effect of these exotic animals on the environmental chemistry and the biological aspects of eutrophication. The large volume of partially digested fecal material from these animals released as nutrients and minerals back into the water are then recirculated into primary producers such as algae which are not normally controlled by the bio-control agents. The algae may succeed to rooted macrophytes; however, the chemical interactions resulting from algal growth seem to perpetuate the algal blooms enhancing eutrophication unless the biological materials can be cropped or removed. Thus, one of our concerns is the basic problem of perpetuating a harvesting and maintenance program to balance the primary productivity against the primary consumer organism if it is indeed the biological control agent itself. The use of planktonic feeders may have to be employed, for example, when you use a macrophyte feeder, which in turn must be utilized in proportion to its primary productivity to maintain an ecological balance in both the energy and nutrient flow throughout the various trophic levels. Few ecosystems can actually be physically controlled well enough to allow a free use of biological control agents. Further, no present controls exist that can effectively restrain the unwise stocking of many organisms throughout the United States. Thus, I believe the problems I have mentioned here relative to control of aquatic plants by bio-control agents are of sufficient magnitude to make us "pull in the reins" a bit regarding the introduction of exotics into the aquatic environment.

In summary, an effective program of pest management will have to be carefully prescribed for each situation and recognized advantages and disadvantages of various techniques. For example, mechanical control of aquatic plants has certain advantages in removing the weed masses from the immediate site. However, there are also several obvious disadvantages such as high costs of operation and maintenance in addition to the problems associated with removal, transport, dehydration, and disposal of weeds and the nutrients contained therein. Chemical erradication of aquatic plants also has its undesirable side effects in addition to its possibility of residues, that is, its nutrients are returned directly to the aquatic environment. Thus, we must direct our efforts more toward controlling or manipulating the ecological succession of aquatic plants. The system of integrated plant management should involve chemical, physical, and biological control agents that do not produce problems in themselves. In the future, I should hope to see a growing partnership of Federal agencies in assisting States and localities with their individual problems in the area of plant management. A team effort will be required to control some of the exotic plant problems such as hydrilla. We note that it has expanded its distribution from its origin in Florida to other southeastern States and may be following close along the problem trail of the Eurasian water millfoil.

EXTENSION OF REMARKS BY GERALD MACKIE

I did not have time to address two of the objections to the use of intensive labor: hazard and workforce availability.

Some of you may have seen a chart which purports to be an actual comparison of the hazards of manual release and aerial spraying. This chart compares the Oregon Industrial Accident Insurance for the two. In Oregon this chainsaw rate covers all chainsaw use, including falling and bucking and other heavy and highly hazardous uses. Chainsaw use in thinning and release is much less hazardous, and this will show in the operator's lower experience rating. Buckers and fallers have a death rate of one per thousand per year.

The use of chaps is now an OSHA regulation and can cut accident costs by 50 to 90 percent. Additionally the floating sprocket and the amazing new antikickback chain reduce hazard even further. Nonetheless, no one can deny that the chainsaw is a hazardous tool. But remember that exposure to its hazard is voluntary and that damage is obvious, non-exotic, and possibly more reversible.

The industrial insurance rate for applicators can be misleading because of the difficulty of the worker to prove that a cancer, spontaneous abortion, and so forth are occupationally related. Anyone who has followed the efforts of asbestos, textile, and coal workers to seek compensation for occupational diseases would be well aware of this. Coal miners once had to "prove" that black lung was occupationally related, for example.

As to workforce availability--of course there would not be a skilled organized workforce available tomorrow. A workforce would develop over time as in tree planting and tree thinning. When the mass production hand planting of tree seedlings was first proposed, how many objected to its practicality because of an imagined lack of labor? The workforce availability logic, if consistently applied, would halt all progress--Henry Ford, IBM, Dow, and others would never have dared enter business!

Dr. Etcyl Blair suggested that the chemical industry is unable to bear the costs of development of herbicides for forestry. Perhaps then the forestry industry should invest in a relatively idled national resource--human labor. The creation of a workforce, like the creation of a chemical, is not just something to be blundered upon and muddled through. It calls for investment, planning, experimentation, and imagination.

Our organization, through implementation of workers' control, has made a formerly repugnant task a well-paying and attractive pursuit. We

are currently at our maximum size because of small business set-aside limitations. We probably turn away 20 unsolicited job inquiries a week (25 percent of whom would "work out").

The workforce is there; the organization is potentially there. The organization of a vast, mobile, skilled, and efficient workforce servicing the forestry industry of the Western United States (including the labor shortage areas of the Rockies) is hampered only by structural barriers.

Hazards of Herbicides

Any management decision must consider the risks and benefits of the contemplated action. The logistically simple, low-cost method of mass aeril spraying to enhance forest productivity in service of the need for fiber may be valued more than the health and livelihood of forest citizens and neighbors. If such is the evaluation, the forest industry must realize that it cannot purchase the peace and goodwill of its neighbors through public relations. No matter what the minimum of risk and maximum of benefit, those who suffer the damage do not often appreciate the benefit.

The Forest Service has been repeatedly assured that its use of these agents constitutes no hazard to the population. Although scientific opinion differs, the majority opinion seems to be that data as to toxicity and exposure predict that no hazard will result.

On the other hand, there exist a wealth of strikingly similar complaints associated with aerial phenoxy exposure from the Montagnard tribes of Vietnam to Oregon, Minnesots, and Arkansas--to name a few. It is indeed significant that spontaneous opposition to herbicide use has developed in more than a dozen scattered locales. This phenomenon can only be explained as mass hysteria or the national response of citizens experiencing damage.

This vast collection of ignored and uncollated "anecdotal" data cannot be brushed aside. If reality does not conform to our theory and its predictions, then it is the theory which must be revised, as reality does not go away. One possible explanation for the discrepancy between theory and reality in this issue is the observation that women and children seem to be much more strongly affected than men by exposure, while applicators and researchers are almost all men.

Tw clarify some epistemological confusion, there is nothing inherently wrong with anecdotal data. All "anecdotal" means is that the data are the result of other than a controlled scientific experiment. Most of our management decisions and nearly all of life decisions are made on the basis of "anecdotal" data. To illustrate, the decision to remove thalidomide from the market was based on the anecdotal data of the

presence of hundreds of deformed offspring. It would have been unconscionable to insist on a controlled scientific experiment involving 10,000 exposed fetuses and 10,000 control fetuses before taking action.

There are some who claim that there has been no "proven" incidence of harm in 30 years of use. The standards of proof demanded by those making this claim are such as to virtually guarantee its truth. The damaged citizen must first of all go to lengthy and expensive tests to prove harm, lengthy and expensive tests to prove exposure, and then be able to establish beyond all doubt that harm and exposure are related. The first two hurdles are difficult enough, while the third is impossible since harm can always be ascribed to the operation of some "other" factor. Since those conducting investigations often have a scientific and/or economic interest in the belief that harm is not related to exposure, harm is always ascribed to those mysterious other factors rather than to phenoxy exposure.

Numerous instances of the described process could be cited. One example within recent memory is the couple who complained of water contamination and associated physical ailments. The Forest Service took water samples which turned out highly positive, but the agency failed to inform the couple of the results for months. Since contamination levels were far higher than that thought possible by prediction of phenoxy behavior in the environment, the Forest Service investigation concluded that its samples must have been defective. This <u>continual</u> putting of the cart before the horse has produced a distorted scientific picture.

Another example which easily comes to mind is the Hoedads' experience with the chemical, thiram, once used as an animal repellent in tree seedlings. The following process I wish to describe as the "citizen's cycle," and I offer it, with all due humility, to professional toxicologists as a model for the evaluation of citizens complaints:

Years ago we treeplanters were asking, "what is this funny white stuff on the trees we handle all day long?" We were told not to worry. Then people began to notice that whenever there was the white stuff, people got sick. We were told that this was impossible. Then people went down to the libraries, found out that the funny white stuff is thiram, that it is toxic, and that our symptoms are identical to thiram poisoning. When we pointed this out, we were told that yes, it may be a little toxic, but you can't possibly be exposed to enough of it to get sick. Then followed years of medical verification and the rallying of scientific opinion. When finally we had proved both harm and exposure (though our opponents would not concede the relationship of the two) and were close to gaining governmental action, the lobbyists came out and predicted the collapse of the forest industry should thiram be denied to it. In the meantime, most managers have abandoned its use not so much because of concern over its toxicity--but because of increasing recognition of its <u>uselessness</u> as a management tool.

I was seriously poisoned by thiram, and, believe me, it is very disturbing when a scientifically and economically interested "expert" will declare to the public that your suffering is merely a delusion. Similarly, to hear lobbyists predicting the collapse of the forest industry publicly--but privately admitting their suspicions that the substance is useless. This experience has made me quite skeptical. My objectivity now favors the citizen over the scientist, the safety over the benefit.

Samuel Johnson, in a philosophical dispute, proved that the world exists by kicking a stone.

Last week, just as I was preparing to attend this symposium, one of our crews came down with "mass hysteria" while working on a unit recently treated with 2,4,5-T. Half the crew experienced flu-like symptoms. One woman began to bleed from every orifice.

Some scholastics maintain that these "stigmata" could not be caused by exposure to 2,4,5-T; rather they are psychosomatic or the result of divine miracle.

I lack the faith. I kick the stone.

FURTHER SUBMISSIONS BY GERALD MACKIE

Hoedads Co-Op Incorporated Presentation at the Western Forestry Conference, November 1977, Seattle, Washington

Hoedads is the largest forestry-based work cooperative in the Northwest. As part of the wood products industries, we are concerned with the health of the region's timber economy. These concerns include: improving silvicultural practices for long-range forest productivity; developing more effective techniques of intensive management; better utilizing our hardwood resources; creating more jobs and a skilled labor force for forestry work; and protecting forest workers from occupational hazards.

Manual conifer release is a silvicultural tool that needs to be further developed. In some locations manual brushing may be the only option other than "no management." For example, sensitive areas such as buffer strips along Class I streams or municipal watersheds may fall into this category due to legal restrictions. It is also possible that manual release may begin to look more attractive to foresters working in inhabited watersheds with substantial local opposition to herbicide spraying.

Besides being a viable option for accomplishing vegetation management objectives, manual brushing also is a source of jobs and dollars in areas of chronic underemployment. The workforce does exist for such labor-intensive forest practices, but it will be developed over time as has happened in reforestation.

Vegetation management is too complex and too variable from site to site for responsible foresters to limit themselves to one option when others are available. Conversely, it is inadequate to reject manual brushing as an option on the basis of a few apparently unfavorable experiments, when favorable comparisons exist as well. There is insufficient information for cost-effectiveness comparisons between herbicide release and manual release, just as unanswered questions and unquantified "costs" leave the risks of herbicide use yet undetermined. The costs of manual brushing vary greatly depending on the age and condition of the site. Experiments need to be performed in the field under a variety of conditions, with different species-associations, at various times of year, on various-aged stands.

Hoedads Cooperative performed four manual brushing contracts in the summer and fall of this year: conifer release (Alsea District of the Siuslaw National Forest), roadside brushing (Cougar Engineering Zone, Willamette National Forest), pre-burn site preparation (Eugene BLM), and cutting of maple sprouts (Eugene BLM). All were new types of work put out as alternatives to herbicide use, and each demanded a different approach. Two contracts are described below:

Hand release of conifers, Alsea: This was really a site rehabilitation release unit of 33 acres, cut in 1963, burned in 1964, planted in 1965, logged across 1975, sprayed (site preparation) 1976, replanted and tubed 1976, and put up for experimental hand release in the summer of 1977. It had a northwest aspect, steep, with a west bottom. Dense stands of vine maple, big-leaf maple, red alder, and salmonberry covered the lower two-thirds of the unit, with thimbleberry on the upper third. In short, a problem unit, not comparable to other younger, less developed brushfields.

The contract was bid at $189.94 per acre; a change order subsequently reduced the total contract price by $493.74. It took a total of 1263 hours to complete the contract--certainly not a very profitable effort. We learned that small chainsaws were far more productive for most brush cutting than hand tools. Six test plots were laid out to get a representative sampling of different kinds of brush and different tools' effectiveness. Results ranged from production rates of 12-70 hours per acre, with widely varied brush types and tools. One contract specification which seriously hampered production called for cutting the brush to 2" stems; this proved to be extremely slow, especially on larger hardwoods. It was eventually changed at a price reduction to 6" maximum acceptable stem height.

Overall, this contract was admittedly an experiment for both the land manager and the contractor. It was a problem unit, not released with maximum efficiency, but, for that matter, herbicides had already been tried without success.

Hardwood control, cutting of big-leaf maple sprouts, Eugene BLM: In the summer of 1977 Hoedads performed 48 acres combination release for established conifers and site preparation for planting. Units ranged from 2-10 years since planting, and price range was from \$32-\$56. Specifications required that big-leaf maples be cut to 6" stump height and felled away from leave trees in a 2' radius. BLM foresters suspected that Tordon treatments translocated through the soil to damage nearby conifers that had recently been planted. This contract was an attempt to find an alternative to Tordon treatments. Foresters were satisfied with the costs and results of the manual treatment, and contractor production ranged from 1/3-1/2 acre per person per hour.

More manual release experiments are needed to refine our knowledge of effective treatment. Intensive forestry is only beginning to explore the array of valuable tools we may have available for vegetation management. "No management" and "herbicide spraying" are not the only options available, and we suggest research in the following areas:

1. Experiments or experimental contracts should be designed to determine the best time of the year for brushing; to determine the most effective kinds of brush, to release different species associations, and different brushfield ages.

2. Experiment with combining several different reforestation treatments at one time, for instance, thinning, hand release, hand site preparation, and planting as one contract operation, rather than letting them separately.

3. Studies comparing manual release and chemical release on similar sites to determine the nature and frequency of conifer damage and subsequent growth rates.

4. Studies comparing the impact of chemical and manual release on forest soils. This also includes consideration of the soil-building qualities of red alder, ceonothus, and other herbicide targets.

5. Herbicides and manual brushing are merely two approaches to vegetation management in the forest. Other approaches that may fruitful in the long run and should be encouraged include:

a. Better utilization of target hardwoods, especially red alder both for its commercial value as pulp or as lumber for furniture and for its silvicultural value as pioneer species, nitrogen-fixer, poria-fighter, humus builder. In short, some target "brush" may be the most beneficial and cost-effective soil-building mechanisms around--more effective and cheaper than urea fertilization. Again, the economic advantages of greater hardwood utilization are obvious, especially in areas such as Tillamook County.

b. Planting shade tolerant species on sites that are likely to have serious brush problems, such as steep, north-facing coast range slopes. In particular, hemlocks, cedar, and sitka spruce are potentially valuable options for future plantations.

c. More experiments with limited sheep grazing in brush and grass problem areas. First indications from Oakridge (W. N. F.) and Tiller (U. N. F.) Ranger Districts are encouraging. The carefully controlled grazing could have its own economic benefits, as well as paying its own way (with per unit fees), as a brush control mechanism. Intensive management, by its nature, will include varied economic and ecological processes in the future, and properly should do so.

In the current political controversy over herbicides, proponents and opponents would do better to speak and listen more carefully to one another. In order to lift the level of understanding about the real range of possibilities in vegetation management, we need to design positive experiments to explore the capabilities and limitations of each potential tool available to the land manager. We must define, refine, and develop those tools for vegetation management which are acceptable to "both sides" in the controversy. We can work for and reach areas of agreement because, in the long run, we all have the same management goals--to promote the economic well-being and ecological balance of our forest lands and the communities dependent upon them.

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<u>Vegetation Management by Fred Miller of Hoedads</u>

Public foresters, under increasing pressure to provide justification for making more timber available to private industry as well as intensified management of public lands, have increasingly turned to herbicides to the exclusion of other methods of vegetation management. Foresters in the private sector manage their lands with maximizing the return on their investment as the guiding motive. The academic community has in many cases led the drive to utilize chemicals to the exclusion of other types of research. Herbicides are viewed as the most economical means of producing more timber and in many foresters' opinions <u>the</u> answer to vegetation control. This paper disputes that view and further suggests that present silvicultural techniques are short-sighted and very possibly detrimental to the future well-being of our forests. The underlying thread is that there is an immediate need to conduct research and experimentation in a number of different areas of vegetation control and begin to answer some of the critical complex questions facing foresters.

Our main concern, and the one that has caused so much controversy in the past few years, is the safety of herbicides. The reasons there have been investigation into methods of vegetation management other than herbicides are the safety/health questions associated with herbicide usage. Most foresters do not and have not recognized the

extent of the concern by the public and by some people in the industry; there has been a tendency to dismiss complaints and questions as coming from people that are anti-business or opposed to progress or know-nothings. Consequently, the spontaneous response to herbicide use has increased and will continue to increase unless foresters face their social obligations.

Many foresters have used herbicides for over 20 years and have had no ill effects from spills, walking on sprayed units, handling different chemicals, and other exposures--nor have they seen any health effects of their co-workers. They simply cannot believe that people can say herbicides are harmful when their own experience has been free of difficulties. However, there is a slowly accumulating body of evidence that is pointing to herbicides as harmful environmental contaminants. Some of this evidence is anectodal, that is, evidence obtained without a control mechanism. This evidence is generally looked down on because of the lack of "scientific" accreditation. It should be noted that much scientific investigation takes place because of indications of potential harm from incidences of anecdotal evidence. Sexist stereotyping is prevelant when talking about anecdotal evidence because there is a tendency to discount women's experiences with the attitude, "women always have something wrong with them." The other kind of evidence that is accumulating is research done by scientists. There is at present evidence showing that some herbicides have the potential to cause cancer, genetic disturbances, and birth defects. This is not to say that anyone exposed to herbicides is going to have cancer or funny chromosones, but it is to say that the possibility exists and cases have been documented. Toxic substances such as herbicides can alter basic cellular mechanisms. They are different in kind than substances that are toxic if taken in significant dosages; for instance, eating many aspirins or several tablespoons of salt may harm or kill you, but it will not alter your cellular structure. There is no comparison.

I am recounting two different kinds of evidence that will illustrate our concern. One of the examples happened this month and is given as the continuing kind of sloppy and questionable use of herbicides. The other is to show the long-range effects that are possible and do not show up immediately on contact.

Two weeks ago three Hoedad crews were working a 22-acre unit for Coos Bay BLM doing tree planting. They were on the heavy-brush unit for 3 days. A majority of the planters suffered symptoms of herbicide poisoning (nausea, headaches, respiratory problems, slight rashes), and one person suffered bleeding of the mucous membranes. We are getting a blood test done to determine if there are any contaminants present. Our crews have been working in Coos Bay for the past 2 months and have experienced none of the above symptoms. This unit was also the first unit they worked with a recent history of spraying. As is usually the case, not all people were affected in the same

manner, and some people were not visibly affected at all. Because of the immunology systems being different for each individual, this is a common experience. There remains substantial danger to workers in the forests when working on recently sprayed areas.

Yoder, Watson, and Benson did a study of 42 herbicide applicators and utilized 16 controls in their study over a 6-year period. Their study showed an increase of nearly four times the number of chromatid gaps over the controls and 25 times the number of chromatid breaks. It also showed there was cellular compensation during the off-season in an attempt to repair damage.

An important secondary concern is the specific effects of the use of herbicides on the forest ecosystems. Effects of forest floor decomposition, nitrification, microorganisms in the soil, soil leaching, and other phenomena need to be investigated. Kimmens (1975) has an excellent summary of the problems facing foresters and the gaps in our knowledge.

Manual conifer release is a silvicultural tool that has been ignored up until the past year; and while it is not the answer, it is a likely addition to the bag of tools foresters so often talk about.

There have been several attempts to make cost comparisons between using chainsaws and herbicides to do conifer release. These attempts are bound to fail because there is insufficient evidence to make cost comparisons. Further, there is difficulty in making across-the-board statements about economics since the site conditions vary immensely from place to place. We can attempt to standardize the cost components of these two methods, however.

For herbicides the costs should include: the price of the chemical per acre and the carrier that is used, the labor involved in transportation/handling/mixing/loading, the helicopter/pilot, monitoring program, and post-treatment inspection. The monitoring program would include sampling of soil and streams, including downstream immediately before the first outtake for human consumption, at 24 and 48 hours and then weekly intervals for a minimum period of 1 month. The monitoring program should be methodical and diligent. The post-treatment inspection should utilize a system similar to what the Forest Service now uses for pre-commercial thinning--noting damaged trees, successfully released trees, and the addition of noting effects on target vegetation. Both monitoring and inspection should be done by government agencies.

For chainsaws the costs would include: operating expenses (gas, oil), labor, and the same inspection as above.

These would be the basic costs for each method. In the case of herbicides adverse climatic conditions obviously would push costs higher because of the down time involved. In the case of chainsaws the costs would be extremely variable because of site conditions. Actually the labor costs would be the only variable. For instance, if conifer release is on a 2- to 4-year-old plantation, then costs would be lower than release on a 10- to 25-year-old brushfield.

We can look at some direct comparisons between the two methods.

1. Saws immediately release trees; herbicides take anywhere from one month to a year and a half to kill or suppress target species. In conjunction with this:

2. Herbicides inhibit growth of conifers. (Gratkowski, 1961, has verified this; however, the rate of inhibition has not been documented to my knowledge--nor has the rate of growth due to release.)

3. Visible damage appears with both methods. Siuslaw National Forest field reports suggest that visible damage is present in varying degrees to conifers. However, again, there has been little research on morphological abnormalities and what the result of herbicidal effects on cell extension and cell division is on conifers. Visible damage from saws includes saw nicks and trampling.

4. The rate of resprouting has not yet been documented extensively. Cutting brush is known to stimulate basal sprouting and this is one of the main arguments against using saws for conifer release; however, there has been no research done to find out the extent and rate this occurs and the difference between brush species. Flagging and basal sprouting also appear with herbicides and, depending on the effectiveness of the application, would seem to be a similar problem.

5. Chainsaws are extremely selective to target species, whereas herbicides cannot approach the specificity. The initial vegetation kill is 100 percent, whereas herbicides vary significantly in the initial-kill percentage.

5. Saw work can be done year-round in most areas in the coast range, and although there are optimum times to cut brush (based on plant physiology, not verified in the field), there is a wide latitude when saws can be used. Herbicides, on the other hand, have a very critical time when they are effective on brush and not on crop trees. Bud-break sprays (late winter, early spring) is the optimum time [sic] to spray for conifer release. This is a period of about 2 months, and during this time climatic conditions play a part in limiting the number of days when it is possible to spray. Late foliar sprays (mid-summer) are also used for conifer release, but the potential for damage is much greater, because a second growth flush is possible for conifers if it rains.

Conifer release with a chainsaw is a relatively new tool, and like for all new tools, there must be research and continual experience to develop it. Although conifer release is similar to pre-commercial thinning and somestimes is combined with it, there are important differences. The most important is, of course, the difference between maintaining a stand of trees and establishing a stand. The costs involved in the latter are substantially greater.

Below are some of the research questions to be answered using saws to release conifers --

-- How fast does brush resprout?
-- What seasons are the optimum times to cut brush?
-- What is the rate of release to the crop tree?
-- Does brush have to be cut every year?
-- Can brush be cut and piled around the crop tree as a mulch to inhibit sprouting?
-- What are the comparisons between release for young plantations and old brushfields?
-- What is the nature and frequency of conifer damage?

Herbicides and manual brushing are merely two approaches to vegetation management in the forest. Other approaches that may be more fruitful in the long run. One of the most promising ways of dealing with extensive brush problems is to utilize shade-tolerant species, the so-called minor species: spruce, hemlock, and cedar. All three species grow well in shade. There are indications that hemlock container seedlings will be more extensively used since the problems with stock seem to have been solved. The supply of cedar is rapidly being diminished, and none is being replanted. Cedar is becoming an "endangered" species if we look at the volume that was once available. Extensive use of shade-tolerant species means confronting the sttitude of growing only those species that are currently "commercially" valuable. The overwhelming attitude that dictates current silvicultural practices is one of short-term economic interests and does not consider the long-term effects on the forest community.

If we objectively consider the extensive efforts to eradicate red alder (burning, cutting, spraying); establish Douglas-fir plantations (planting, release spraying) and then dumping large quantities of urea fertilizer on the plantation in order to give a nitrogen boost to the conifers, we would conclude that it is stupid. There is no other way to describe this effort. Red alder is a prodigious fixer of nitrogen in the soil; the current efforts are energy consuming, expensive, inefficient, and harmful to the forest soil.

Eradicating all brush species without an investigation of how much aid they are in building the forest soil is another example of poor management practice. The interrelationships of the forest ecosystem and what happens when it is disrupted are only begun to be investigated.

If forests are going to be managed intensively, and I believe they should, then it is incumbent upon all foresters to make maximum use of all components of the ecosystem in combination. There should be biological control of vegetation as well as mechanical and chemical control. As long as foresters in both the private and public sectors see dollar signs growing in the forests, there will be opposition to the practices that maximize only economic returns and do not consider the forest as an integrated living system.

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<u>Proposals</u>

All applicators should be required to take rigorous theoretical and practical training courses in herbicide use, and their knowledge should be upgraded regularly.

All applicators should be thoroughly tested before and after spraying season. This would include blood tests, semen counts, and erratic illness patterns and would continue as long as they worked as applicators. This should be written into contracts.

All planners and managers should be required to have a good understanding of public health and ecological aspects to use of herbicides.

The timing of spraying should be all-important with on-site inspection immediately prior to spraying to determine condition of both target and non-target species. (Generally recognized spray periods may vary significantly depending on site, climate, aspect, etc.)

Watersheds that are direct supply for human consumption should not be managed with herbicides. Alternatives should be developed.

On Class I streams, 100-foot boundaries should be left to minimize drift or late shut-off of spraying. Protecting the water quality is of paramount importance,and those strips can be planted with other species or managed by other means.

All existing alternatives should be examined and used in an integrated management program. Detailed knowledge should be gathered as to the applicability of different solutions in different areas.

Humans should not be exposed to sprayed units until a sufficient period of time has elapsed. The period of time should be defined in relation to the persistence of the specific herbicide.

Extensive research on sub-lethal exposure and long-term effects of herbicides should be accelerated.

Monitoring programs following each spraying should be carried out by governmental agencies with diligence and thoroughness for a minimum period of 1 month.

All public agencies should have ongoing, long-term health studies of employees that come into contact with herbicides. There should be a control group to provide information on long-term effects of exposure to chemicals. A standardized method of testing among the different locations of agencies is necessary.

Extensive research should be encouraged and budgeted for the effects of herbicides on the forest ecosystem. This would include soil microorganisms, movement of herbicides through the soil, synergistic effects of different herbicides, and effects on the plant community--as well as other interrelationships in the forest community.

Extensive research on hardwood utilization, sheep grazing to control brush, mechanical release, biological control of brush, and other methods of vegetation management.

The government agencies--Forest Service and BLM--have increased funds made available in the form of research and personnel to intensify our knowledge of the forest community and how we can utilize more effectively our natural resource.

SUBMISSIONS BY LAWRENCE F. BROWN [1]

Testimony of Lawrence F. Brown

Background Information: Since November 1971 Lawrence F. Brown has been Director of the Josephine County Forestry Department, with primary responsibility of managing Josephine County's timberland assets of 30,000 acres. The thrust and main objective of the management program have been to intensively manage these assets using manpower available through Public Service Employment, the C.E.T.A. program, the former emergency employment program, and unemployed, unmatchable welfare recipients. Prisoner work release programs have also been initiated. Up to 100 C.E.T.A. employees have been used in these activities; currently 75 are employed.

This testimony is not intended to be pro or con on the use of herbicides but a statement of experience relative to alternatives to herbicides. The purpose is to examine the feasibility and the practicality of a massive P.S.E. program through Y.A.C.C., C.E.T.A., or a yet unidentified source of manpower to manually control undesirable brush species occupying valuable potential conifer sites.

In May 1976 the County Forestry Department began addressing the problem of brush fields rehabilitation. A study was conducted to determine the cost of manual brush release on 30 acres of brush-dominated lands. A copy of the brush study is enclosed herein as part of this testimony. The study was done to determine the merits of manual brush release using chainsaws, and it was compared with pre-commercial thinning accomplished in 1976 by public service employees.

In 1976 pre-commercial thinning of 3200 acres cost on an average $114 per acre. Using the same cost accounting system, equipment, organizational structure, and manpower, the three areas of the brush study averaged $707 per acre, or five times that of pre-commercial thinning. It was discovered that 30 percent of the trees included for release from brush competition on the study area were damaged or covered with brush as a result of the activity. Production rates for pre-commercial thinning averaged .51 acres per man-day on 3200 acres, as compared with one-tenth of an acre per man per day in the brush fields.

Injury rates or incidences were likewise compared with a 3-month period of pre-commercial thinning, during which time we averaged one for every 24 man-days of thinning. The injury rate during the brush study was nearly double at one per 13 man-days. It should be noted that due to a funding limitation, no positions had been refilled since September 1976. Consequently, all participants in the brush study as a minimum of 7 months experience in chainsaw operation. For this reason it is expected that injury rates with new or untrained, unskilled employees would be somewhat higher.

1/ With Mr. Brown's permission, certain maps and charts which were a part of his submitted material were not reproduced for this publication.

Absenteeism was high during the study due to the monotony and excessive risks of cutting brush. Also, the fire hazard created was rated "extreme" by the Oregon State Forestry Department. Massive fields of manually severed brush created a fire hazard of immense proportions.

Resprouting of brush plants on the test plots is currently being measured as part of a long-term study. Initial measurement 2 months after the brush was severed showed a 28 percent recovery, on the average, of the original canopy cover.

To date, the only basis for cost evaluations can be and has been to compare this study to forestry co-op experiments. Their data indicate a great deal lower cost than that experienced by this Department. Consequently, their cost accounting systems, methods, and legal responsibilities were analyzed to determine the comparability of co-ops to government agencies, as well as corporations and small private consultants. It is not the intention of this testimony to pass judgment on the fairness of the co-op's corporate laws. It is, however, the intention of this testimony to show why vast differences exist in our cost experiences versus that of the co-ops.

Cooperative corporate law allows these businesses to operate without significant overhead expenses. The following table shows the percentages of increase in base pay of $4.11 per hour and how it is inflated to a $7.20 per hour cost to the county.

PAYROLL EXPENSES OF COUNTY EMPLOYEES
AS COMPARED TO FORESTRY CO-OPS
AS A PERCENT APPLIED TO BASE WAGE

Payroll Expense Items	Studies Percent Added to Base Pay	Forestry Co-op Percent Added to Base Pay
Unemployment Insurance	3.10	-0-
Workmen's Compensation	31.00	-0-
Social Security	6.05	-0-
Insurance-Dental, Health, Life	6.40	-0-
Sick Leave	5.00	-0-
Holiday Pay	3.40	-0-
Vacation Pay	3.80	-0-
Retirement	16.50	-0-
Cash Bonding Fund and Other Overhead Such as Transportation, Equipment, Etc.	15.00	15.00
TOTAL	90.25 Percent	15.00 Percent

This assumes that the overhead costs of 15 percent for equipment and transportation are the same for both forestry co-ops and county. As shown here, the county's costs are over 75 percent higher than forestry co-ops. On the other hand, the employee working for the county on P.S.E. at a base rate of $4.11 per hour has his check eroded by State and Federal taxes (25 percent), social security-FICA (6.05 percent), and Workmen's Compensation (.25 percent), which reduces his take-home to $2.82 per hour.

Employees of the forestry co-op, since they are technically partners, do not pay these costs until the end of the calendar year, at which time they file a schedule C of the income tax return for self-employed workers. Since these individuals work sporadically, averaging 4 months per year, their contributions to these taxes is quite minimal. Furthermore, they may deduct costs of clothing and equipment necessary for conduct of their operations. This information is a result of an interview with the secretary of a local forestry co-op operating in Josephine County. One then must question the dependability of this manpower source in the long run.

On the other hand, the Chief of the Forest Service, Mr. McGuire, stated that we should look at Public Service Employment as a source of manpower as an alternative to the use of herbicides. With 7 years experience with P.S.E., it appears as though there are some inherent drawbacks to this source. For instance, the Y.A.C.C., Young Adult Conservation Corps, is restricted in eligibility to the ages of 16 through 23. Between the ages of 16 and 18 it is unlawful to run power-driven equipment in the State of Oregon, which severely affects this program for manual brush release. Additionally, the State law provides that employees shall receive no more than the minimum wage, which is currently $2.80 per hour. The County Forestry Department's wages begin at $4.11 per hour and are considered quite low for this hazardous, extremely demanding, and arduous task.

C.E.T.A. provides an opportunity to fund manpower for this type of labor-intensive task. However, we must be aware that the cost will be high in terms of turnover rates, absenteeism, and, most importantly, accidents or the risks of accidents. Back injuries tend to become prevalent with employees who have been unemployed for long periods of time or are forced into employment with little motivation.

As Federal Government programs strive to reduce welfare costs and unemployment insurance compensation, the tendency is for stiffer requirements in terms of program operators. Participant eligibility requirements are tightened to assure service to target populations. Current C.E.T.A. laws require 15 weeks unemployment at a minimum. Support costs for materials and overhead dwindle as programs become older, placing more and more burden on program operators.

This is not to say that Public Service Employment cannot be used effectively for intensive forest management and certain forestry techniques, but I have concluded that cutting brush with a chainsaw, either as site rehabilitation or release of suppressed conifers, is not recommended with Public Service Employment employees. We have been successful with reforestation projects, stream clearing, and fish habitat improvement, as well as pre-commercial thinning and hardwood control through chemical stem injection. If a massive program is initiated for manual brush control, we must also be assured that the manpower is available. These individuals must all be roughly the age from 18 to 35, physically fit, with certain lengths of unemployment, and perhaps severe employment handicaps.

With 700,000 to 800,000 acres of brush fields known to exist in Western Oregon and Washington, the program must be massive, should herbicides be eliminated as a forestry tool. The cost of leaving land in a non-producing state would also be monumental. If the alternatives for manual release are either Public Service Employment or cooperative contracting, contracting is fare more cost efficient. If corporate law structures are not changed, the costs will be at least 75 percent less than what our study has shown on similar brush fields.

In the interview with folks from the cooperative, they acknowledged a preference for tree planting, then pre-commercial thinning, and lastly manual brush release. They also acknowledged most individuals working for the co-ops prefer winter work only, so they can work on their farms during favorable weather. This was borne out by testimony from the Hoedads Cooperative, which indicated an annual payroll of $1.3 million and 300 workers, an average of $4,000 per worker per year. At their base wage of $6.00 per hour, this is equivalent to 4 months' work. I seriously question whether cooperatives, even with their high morale, close-knit camaraderie, and financial advantages,would be able to solicit the number of workers required for a massive brush release program.

As brought out earlier in this testimony, they are not required to pay Workmen's Compensation. One must question the fate of the employee or fellow worker who sustains a disabling insury. These questions must be addressed.

IN SUMMARY, with a vast amount of experience running a highly respected P.S.E. forest management program and one considered as large as any existing in Oregon, it is my opinion that Public Service Employment cannot replace the use of herbicides in our forest management programs. Whether or not the massive funding necessary for contracting would be available to replace herbicide application on a continuous basis is also very speculative in terms of a realistic and viable alternative.

Seven Immediate-Impact Consequences Resulting from the Use of a Chainsaw to Control Brush--Art Bernstein, Forester-Technical Writer

Abstract.--The Josephine County, Oregon, Forestry Department manages 24,000 acres of formerly private timberlands. Much of this acreage is brush dominated, and several methods of conversion to conifer forests are being evaluated.

One method, removal of brush with a chainsaw, is presently undergoing intensive testing by the department since no data base presently exists. Twenty-eight criteria are being used in this evaluation. Of them, seven yielded immediate impact results, which are reported herein.

It was shown that: (1 and 2) Thirty-one percent of suppressed, seedling class conifers intended for release are damaged or covered with slash by workers. (3) The cost per acre of brush cutting is five to six times that for pre-commercial thinning, a similar operation. (4) Worker production, on the other hand, is five to six times greater for pre-commercial thinning. (5) The injury rate for the project was twice that for the control period. (6) Absenteeism on one area was the highest ever for the department. (7) The slash hazard created was rated as "extreme."

Acknowledgements.--The Director of the Josephine County Forestry Department, as well as the author of this study, wish to acknowledge the considerable and invaluable involvement of Mr. Virgil Witcher, Forester in charge of the department's silvicultural operations.

Gratitude is also owed Mr. Colin Patrick, Office "everything," and our long-suffering thinning and field research crews, who performed admirably a series of exceedingly demanding and frustrating tasks.

Also, Drs. Ron Stewart, Hank Gratkowski, and Mike Newton, of Corvallis, Oregon, contributed invaluable advice, as did John McCullough, Larry Gross, and Mel Greenup of Siskiyou National Forest, and Decision Research of Eugene, Oregon.

I. The Problem.

The Josephine County, Oregon, Forestry Department is responsible for 24,000 acres of commercial timberland in isolated tracts ranging from 40 to 1000 acres. Located in southern Oregon's Siskiyou Mountains, the County acquired these lands after previous owners logged them and let them revert to the county for tax delinquency. Our lands are therefore unlike Federal lands but very similar to private land holdings. Private owners can, due to the similarity, draw conclusions from County forest management techniques, production rates, costs, and effects.

County policy, as stated in the County's Forest Management Report of 1970, has been to practice intensive reforestation on lands under the department's jurisdiction. The implied policy of managing for conifer production only is currently under review but not expected to change drastically in the near future.

Most studies show that in the Siskiyou Mountains, reforestation (tree planting), if undertaken within the first few years after logging, is reasonably inexpensive by current standards, and quite effective.

If replanting is not undertaken, however, and if adequate natural reseeding fails to occur soon, cutover lands may become overgrown with "brush." In common usage, brush is defined as shrubs and shrub-sized hardwood trees.

Usually, hardwood tree species will eventually crowd out these shrubs and desired conifers will ultimately supplant the hardwoods. This "natural succession" method of restoring logged lands to their pre-logging condition may take up to several hundred years on our lands, if it occurs at all. Management intervention can greatly speed this process (Newton, 1976).

Generally, our lands were logged between 15 and 30 years ago. Many areas are brush dominated, but often the brush is dotted with widely spaced, suppressed conifer seedlings, growing beneath competing vegetation, which will probably die without some sort of "release" program. They are also dotted with clumps of second growth conifers which established themselves before the site became brush dominated.

Our management objective with regard to brush areas is to remove competing vegetation around struggling conifers and replant the in-between areas. Control of undesirable species is generally referred to as "conifer release" and "site preparation," depending on whether the intent is to favor conifers already established or to replant.

Since few would argue with the desire to accelerate the return of brush areas to productivity, the question becomes: How can this best be accomplished?

Of late, all forest management techniques are being questioned, as are techniques <u>not</u> performed due to their seemingly obvious inadequacy from the forester's viewpoint.

Public statements have been made regarding one such alternative, that mechanical brush eradication is a workable alternative in lieu of the use of herbicides. It has also been stated that many jobs can be created by this method, thereby relieving high unemployment (Yost, 1977).

Fortunately, our department employs many federally funded C.E.T.A. workers. Thus, in evaluating various brush control methods, we are able to relegate costs to a temporarily lower priority during short periods of experimentation. Most forest management organizations are not in such an advantageous labor-intensive situation.

Using a format called "Decision Analysis," we generated nine alternative methods of brush control (see appendix). Since controlling tree-

size hardwoods may pose different problems, this was left for another study, even though some of the alternatives considered had this as an additional benefit.

Many brush control alternatives involve the use of herbicides. Such chemicals, especially those applied by spraying, have recently come under attack and been the subject of litigation.

In researching professional literature, however, it became obvious that a data base for mechanical (non-herbicide) brush control alternatives was not available. This is especially true of alternatives which are "species selective," removing only undesirable species while posing no danger to established reproduction.

The present study, therefore, attempts to establish such a data base for one non-herbicide, species selective means of conifer release and site preparation, "removal of brush with a chainsaw."

Decision Analysis evaluates <u>all</u> alternatives in terms of <u>all</u> consequences resulting from them. Thus, data on "toxic reaction to herbicides by animals" must be compiled for alternatives not involving herbicides. In such an instance, of course, the value would be zero.

We were able to generate 28 measurable consequences by which to evaluate our nine alternatives, as well as the single alternative under current scrutiny (see appendix). This paper will describe the results of seven of these consequences, all having the feature of immediate impact measurability.

Other consequences are either long-term or of zero value. Long-term consequences, such as resprouting, are being measured. Before a final decision is made as to which alternative will be employed by our department, data on all consequences of all alternatives will be compiled and evaluated.

II. <u>Study Design and Background Information</u>.

For our study we selected three areas representing three somewhat different situations (see figure 2). Work was done in late April and early May 1977.

1. <u>Butte Creek</u>. Prior to treatment, brush areas within this 10.26-acre tract had a 90 to 95 percent crown closure consisting primarily of deerbrush (<u>Ceanothus integerrimus</u>) approximately 50 to 10 feet tall. Minor species consisted of poison oak (<u>Rhus diversilobum</u>), oceanspray (<u>Holodiscus discolor</u>), and mountain whitethorn (<u>Ceanothus cordulatus</u>). There was also scattered grassy openings and occasional larger mandrones (<u>Arbutus menziesii</u>) 15 to 20 feet tall. Conifers were mostly Douglas-fir (<u>Pseudotsuga menziessii</u>) and sugar pine (<u>Pinus lambertiana</u>).

2. Clark Creek. Prior to treatment, this 15.49-acre tract differed from other study areas in that succession to larger hardwoods and conifers was further along. This tended to occur in clumps or groves, with brush areas interwoven.

The brush areas had an 85 to 90 percent crown closure. Dominant species consisted of varnishleaf or snowbrush (*Ceanothus velutinus*) 5 to 6 feet tall and occasional hairy manzanita (*Arctostaphylus combiana*). Hardwoods, consisting of canyon liveoak (*Quercus chrysolepsis*), golden chinkapin (*Castanopsis chrysophylla*), vine maple (*Acer circinatum*), and mandrone were present in shrub size or larger. Conifer species consisted of Douglas-fir and sugar pine.

A 1-acre control plot was established within the tract and is not included in the acreage.

3. Bear Wallow. Prior to treatment, this 4.61-acre plot contained brush with almost 100 percent crown closure. It consisted of Pacific serviceberry (*Amalanchier florida*) 5 to 10 feet tall and several manzanita species 1 to 3 feet tall. Minor brush species consisted of mountain whitethorn, oceanspray, and deerbrush. The brush was intermingied with shrub and tree-size hardwoods of tanoak (*Lithocarpus densifloris*), canyon liveosk, and golden chinkapin. Conifer species consisted of knobcone pine (*Pinus attenuata*), a tree of no commercial value, grand fir (*Abies grandis*), and Douglas-fir.

A 1-acre control plot was established within the tract and is not included in the acreage.

Our approach to the project was basically an extension of the department's extensive pre-commercial thinning program, wherein workers use chainsaws to achieve desired spacing between trees in young conifer stands.

In conifer-dominated stands, brush poses few problems and small patches of it are usually circumvented by workers. Tree-size hardwoods (1 inch DBH or larger) are left standing and later treated with a herbicide applied individually to each tree.

This project differed only in that workers were instructed to cut all shrub and shrub-size hardwoods at ground level. Conifers were spaced to the usual 10 feet by 10 feet, where applicable, and large hardwoods were left intact. Poison oak was also left intact due to the risk of skin irritation from contact.

Silvicultural data were based on this department's established stand analysis system used before and after all treatment programs. It consists of tallying all trees within an 11.3 feet radius circle (400 square feet), with the circles or "plots" spaced at regular intervals.

In this case, spacing was 1 chain (66 feet) by 2 chains, measured by pacing. This came to 63 plots at Butte Creek, 75 at Clark Creek, and 27 at Bear Wallow.

Figure 1

DESCRIPTIONS OF STUDY AREAS

	Butte Creek	Clark Creek	Bear Wallow
Location (Wallamette Meridian)	T34S-R7W-10	T33S-R5W-26	T39S-R6W-26
Property Acreage	360 acres	160 acres	80 acres
Study Area Acreage	10.26 A.	15.49 A	4.61 A
Elevation	1500 feet	3200 feet	4200 feet
Slope	20-30 percent	30-40 percent	20-45 percent
Aspect	Southeast	East	East
Principal Brush Spp.	Deerbrush	Snowbrush	Pacific service-berry, manzanita
Minor Brush Spp.	Poison oak, oceanspray, mtn. whitethorn	Hairy manzanita	Mtn. whitethorn, oceanspray, deerbrush
Hardwoods	Mandrone	Mandrone, canyon liveoak, golden chinka-pin, vine maple	Tanoak, canyon liveoak, golden chinka-pin
Conifers	Douglas-fir, sugar pine	Douglas-fir, sugar pine	Douglas-fir knobcone pine, grand fir
Site Index	Low IV	Mid to upper IV	Low III
Pretreatment Conifer Stocking	169 trees/A	996 trees/A	194 trees/A

Other data were based largely on our department's cost accounting procedure. Full details of this comprise a 12-page document. However, a general breakdown of costs for the study area is shown in the appendix.

Controls are either pre-treatment stand analysis data or comparison with similar data in past pre-commercial thinning projects.

III. Immediate Impact Consequences of Removal of Brush with a Chainsaw.

1. Stocking per acre after treatment.

Site	Pre-treatment Stocking	Post-treatment Stocking
Butte Creek	169 trees/acre	91 trees/acre
Clark Creek	996 trees/acre	676 trees/acre
Bear Wallow	194 trees/acre	181 trees/acre

The above figures include all conifers regardless of size class. Of the conifers remaining after treatment, trees in the "seedling" size class (1 inch DBH or less, even though they may be many years old), can be considered as having been released from direct brush competition. This is because pre-commercial thinners cut away all seedling size trees growing within 10 feet of a larger conifer. Thus, to have escaped the thinners' saws, a seedling size tree would have to have been growing by itself, away from other conifers. In such a case, it would, in all probability, have been growing in the midst of a brush area but would not be of sufficient size to have risen above the brush.

Of course removal of competing brush is advantageous to all remaining vegetation regardless of size class, but seedling size trees present a special circumstance in that they are our "targets" for release.

Post treatment counts of seedling size conifers were:

Butte Creek-- 48 trees/acre
Clark Creek--570 trees/acre
Bear Wallow--141 trees/acre

2. Physical damage to released conifers.

In our followup analysis, seedling size conifers not removed in thinning were classified as "damaged" (by trampling, saws, or slash), "covered" (by piled slash), and "free to grow" (or effectively released). The results were:

Butte Creek--20% damaged, 12% covered, 68% free to grow
Clark Creek--10% damaged, 21% covered, 69% free to grow
Bear Wallow--17% damaged, 10% covered, 73% free to grow
TOTAL --11% damaged, 20% covered, 69% free to grow

Thus, post-treatment counts of seedling size trees should be revised to five an accurate estimate of conifers effectively released from brush competition. This yields the following revised count:

Butte Creek-- 33 trees/acre
Clark Creek--393 trees/acre
Bear Wallow--103 trees/acre

3. Costs per acre.

This is based on our established data on pre-commercial thinning which, as stated, closely resembles the present study.

Pre-commercial thinning of 3198 acres during calendar year 1976 cost this department an average of $114.58 per acre, ranging from $74.54 to $157.35 per acre. Costs include wages of workers and field supervisors, State Accident Insurance Fund premiums (amounting to $32.13 per $100.00

for thinners), fringe benefits, materials, transportation, amortization of equipment, etc. (see appendix). As per our cost accounting system, costs per acre for the brush study were:

Site	Total cost	Cost per acre
Butte Creek	$ 5,708.99	$ 556.43
Clark Creek	9,914.57	640.05
Bear Wallow	5,849.28	1,268.82
TOTAL	$21,472.84	$ 707.27

These figures may appear grossly inflated when compared with some cost estimates by certain groups which have been quoted at public hearings and in print. However, we feel our accounting system gives a full and accurate picture of all costs involved in such an operation (Yost, 1977).

Nevertheless, a "minimum cost" may also be derived, based strictly on wages paid only for work actually performed, comparable to contracting co-operatives in which workers are, in effect, private sub-contractors. Presuming the worker provides his own saw, gas, oil, safety equipment, and transportation, and eliminating supervisory costs, time paid for travel to the job site, hiking to the work area, work breaks, saw maintenance, fringe benefits, and S.A.I.F., the following cost figures are derived, based on our average worker wage of $4.02 per hour:

For our 1976 pre-commercial thinning program, this would yield a revised minimum figure of $36.54 per acre, ranging from $22.35 to $59.65 per acre.

For the study project, revised minimum costs are:

Site	Minimum cost	Minimum cost per acre
Butte Creek	$1556	$151.63
Clark Creek	2613	168.68
Bear Wallow	1483	321.69
TOTAL	$5652	$186.16

Note that using either method, brush cutting is still five to six times more costly than pre-commercial thinning.

Viewing "total cost per acre" in combination with "trees effectively released," we can multiply the trees released per acre by the acreage and arrive at the total number of trees released. Dividing this by the cost of treatment for the area will yield a cost per tree for release. This comes to:

Site	Trees released	Cost per tree
Butte Creek	308	$18.53
Clark Creek	5607	1.76
Bear Wallow	438	13.35
TOTAL	6353	$ 3.38

The total, however, was thrown off by the far greater number of trees at Clark Creek. It should be noted, though, that there is a close inverse correlation between cost per tree and the pre-treatment ratio of brush to conifers. The more conifers, the lower the cost per tree. It should also be noted that our average cost for pre-commercial thinning of $114.58 per acre, thinned to 10 by 10 feet (or 436 trees per acre), comes to 26 cents per tree released.

4. Production rate.

Production is measured by our department in terms of man-days (md's). Since we work a 10-hour day, one md equals 10 man-hours.

As a control we compared production on pre-commercial thinning projects, as described earlier. It took our workers 6225 md's to thin 3193 acres in 1976. This came to an actual production rate of .51 acres per md (or per man per day), including travel time one way, field supervision time, and break time. Time actually spent running a chainsaw came to 2903 md's for a maximum production rate of 1.1 acre per md.

Production rates for the project areas were as follows:

Site	Total md's	Md's running saw only	Actual production rate	Maximum production rate
Butte Creek	85.05	38.7	.12 ac/md	.27 ac/md
Clark Creek	145.3	65	.11 ac/md	.24 ac/md
Bear Wallow	84.9	36.9	.05 ac/md	.12 ac/md
	312.25	140.6	.10 ac/md	.22 ac/md

Here again, the figures for brush cutting are consistently five to six times greater than for pre-commercial thinning. This is doubtless due to the difference between falling pole shaped conifers and cutting up large shrubs in which hundreds of branches up to 10 feet long may radiate from a single short stem at ground level.

Lest our employees be accused of "slacking," it should be noted that no new employees had, at the time of the study, been hired since September 1976. Thus, our crews were highly experienced, with marginal workers long since weeded out. This, of course, would also tend to raise our costs slightly because of longevity pay increases. On the other hand, it would be offset by increased efficiency.

5. Injury rate to workers.

The following is based on reported injuries only, requiring first aid, medical attention, or deemed serious enough to warrant the filling out of an accident report form by a foreman. Foremen were

unaware that we would be examining accident reports for the project period, only costs.

Injuries were measured in terms of man-days. Our control was the period from November 1976 to March 1977 viewed as comparable because it included only experienced workers.

Only days on which crews were engaged primarily in thinning were tabulated for the control period. However, all injuries were counted which occurred on those days whether or not they occurred while thinning. This is because our running list of reported injuries gives the date and employee's name only. Other information can be determined only by researching personnel files.

To be consistent with the control, only injuries occurring on days that crews were working at the study areas and all injuries occurring on those days were tabulated. Administrative man-days were excluded.

Month	Md's thinning	No. injuries	Injury rate
Control:			
11-76	540	21	1 every 25 md's
12-76	344	13	1:26 md's
1-77	356	16	1:22 md's
2-77	301	13	1:23 md's
3-77	0		
Study period:			
4-77	213	15	1:14 md's
5-77	52	6	1:80 md's
Total for study period:			
	265	21	1:13 md's

It might be noted that hardhats, chaps, and ear plugs are required at all times while running a chainsaw. For the brush study we further required that all employees wear safety glasses consisting of plastic eyeglasses with side shields.

As a casual observation from interviewing workers, brush cutting seems to pose a high risk of minor injury, such as flying twigs in the eye or up a plant leg, bee stings, poison oak, sprains, saw nicks, etc. The risk of major injury, especially chainsaw cuts from "kickback," is viewed by workers as greatly increased.

Fortunately, this department's safety record is well above average, and we've never had a fatality or permanently disabling injury.

6. Absenteeism and morale problems.

Our control was the period of 1-77 to 3-77 because our personnel was essentially the same. New employees are more likely to be unreliable, with the least reliable soon weeded out.

During the control period, only days spent precommercial thinning were tabulated, and only workers engaged in precommercial thinning. Administrative time was excluded. For the project period, similar figures were examined.

Control:

Month	Potential md's thinning	Actual md's thinning	Md's absent	Absentee rate
1-77	420	356	64	15%
2-77	356	301	55	15%
3-77	0			

Study Period:

Month	Potential md's thinning	Actual md's thinning	Md's absent	Absentee rate
4-77	253	213	40	16%
5-77	68	52	16	24%

Total for study period:

	Potential md's thinning	Actual md's thinning	Md's absent	Absentee rate
	321	265	56	17%

Past studies done by this department show the above 15 percent control figure to be exceedingly consistent. Any deviation, therefore, is significant. Absenteeism for May, while workers were at Bear Wallow, was the highest ever for this department. Bear Wallow had the densest brush cover, the steepest terrain, and elicited by far the most complaints.

7. Fire hazard created by downed slash.

In dealing with downed slash, our department has the option to either remove it or pay an added premium to the Oregon Forestry Division for continued protection under conditions of increased hazard. With no slash hazard, there is no added premium above the minimum rate of 38.2 percent per acre.

When slash is created, State Forestry representatives inspect the areas and rate the added hazard on the basis of several criteria, including depth and amount of slash. The maximum added premium is $2.00 per acre. However, no added premium is incurred unless acreage is sufficient for a charge of $50.00.

Following the brush control study, the added hazard created was rated as "extreme." Fortunately, the total acreage was not sufficient on any one property to require an added premium payment (see appendix).

Were we to expand the project to all of our approximately 3000 brush-dominated acres, fire protection costs, already high, would be significantly increased.

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APPENDIX

Brush Control Alternatives:

1. Do nothing.
2. Remove brush with hand tools (axe, brush hook, grub hoe, etc.).
3. Remove brush with chainsaw.
4. Remove with heavy equipment ("pile and burn").
5. Controlled field burning.
6. "Brown" with herbicide and burn or crush with heavy equipment.
7. Aerial herbicide spray.
8. Ground herbicide spray.

Measurable Consequences of Brush Control Alternatives:

1. Effect on rotation age.
2. Stocking per acre (number stems).
3. Continued supply of raw materials (timber receipts).
4. Annual growth per acre (DBH and/or height) of conifers.
5. Cost per acre.
6. Survival of planted seedlings.
7. Physical damage to released conifers.
8. "Shock" to released conifers.
9. Resprouting of weed species.
10. Number of retreatments required to inhibit competition.
11. Production (acres per man-day).
12. Fire hazard created by slash and cost of its removal.
13. Injury rate to workers.
14. Absenteeism and morale problems.
15. Achievement of desired alteration in species composition (will the correct species be released? is the alternative species selective?).
16. Fire damage to established conifers.
17. Soil erosion.
18. Toxic reaction of workers to herbicides.

19. Toxic reaction of wildlife to herbicides (viz mortality and reproduction rate).
20. Toxic reaction to herbicides of non-target plant species (flashback).
21. Reforestation delay due to litigation.
22. Adverse public reaction.
23. Creation of public work jobs.
24. Exposure to toxic substances of domestic animals and humans living near treatment site.
25. Effect on wildlife habitat.
26. Physiologically desirable treatment time (can treatment be accomplished within this period?).
27. Time or cost constraints on reforestation projects.
28. Visual effect of treatment (especially vs untreated areas).

Josephine County Forestry Department--Cost Accounting Procedures

Synposis.--In order to manage programs and evaluate effectiveness, cost accounting is essential. It also is a necessary tool in determining budget and fiscal management.

Our cost analysis also serves to determine feasibility of forest management alternatives for future management decisions. Feasibility must apply not only to county government but also to private industry. If properly set up, cost accounting may offer private industry and other government agencies an opportunity to decide on forest management alternatives.

Government seldom exercises a lead role in fiscal accountability on private industry standards. This accounting system is an attempt to do just that.

Our purpose in this accounting system is to determine the REAL cost of our activities. To do this, the following items are included:

Personal services: Base pay for month to individuals, including fringe benefits (S.A.I.F., retirement, insurance, etc.). All fringe benefits except sick leave, holidays, and vacation.

Materials and services: Vehicles are amortized on 4-year life expectancy or actual lease cost. Gas and oil are calculated by cost per mile based upon typical experience. Repairs are charged to vehicle for given month. Crew equipment is amortized upon expected life to cost per day. Gas, oil, repair are prorated based upon actual costs from experience and applied to each day equipment is used.

Overhead: Non-working employees are charged to a given area based upon amount of time spent. All foremen's time is charged to the crew works. Some of the supervisors' time is identified to a given area.

No administrative time above that level is charged. Also not charged are Director, clerical, and Foresters. These individuals are charged at the end to personal services on a percentage basis since their duties may entail other activities.

Capital outlay: Includes all purchases over $50 and are prorated to life expectancy.

Precautions in using and interpreting the data presented by this system:

1. Only man-days actually worked are charged, therefore those sick, on vacation, or holidays are not reflected in the accounting system. To take this into consideration would increase our personal services by almost 15 percent.

2. Some CETA employees (i.e., mechanic, bookkeeper) are not charged to any activity.

3. Purchase of capital outlay equipment is prorated or amortized over life expectancy and not charged all at once to a given activity or area.

3. Individuals off work on S.A.I.F. claims continue to accumulate sick leave, vication, etc., while not present for work for usually a month or so. Those costs would not be reflective in an activity.

5. Lost time for administrative details if less than one-half day would be charged to an area or activity--those would include: travel time (to job site only), maintenance one-half hour per day and 1 hour on Friday for cleaning crew equipment, safety meetings, department information meetings, etc.

SUBMISSIONS BY ANDY COLONNA[1/]

The Group for Organic Alternatives to Toxic Sprays (GOATS) formed in February 1977 when widespread complaints of "mishaps" followed helicopter spraying of phenoxy herbicides in forested areas. Spraying is intended to kill the tops of competing hardwoods (oaks, mandrone, etc.), while leaving the commercially valuable conifers such as Douglas-fir relatively unaffected. This helps the conifer trees to grow faster.

GOATS has researched many complaints from the Northwest region. There is evidence to support concern that a bi-product formed in making some phenoxy herbicides is extremely poisonous and often persistent in the

[1/] With Mr. Colonna's permission, certain maps and charts which were a part of his submitted material were not reproduced for this publication.

ground. It is absorbed by fish, livestock, and humans. The container labels warn users, "DO NOT USE THIS PRODUCT WHERE RUNOFF IS LIKELY TO OCCUR." But despite efforts to control the spraying operations, wind drift, unexpected rain, and accidental spills have deposited herbicides into sensitive water systems. Consequently, we are uncertain that these chemicals can be "used as directed."

In April GOATS contacted the Six Rivers National Forest to discuss an alternative to spraying. We offered to volunteer our time, and the Forest Service agreed to provide tools and advice, to experiment with cutting hardwoods by hand in a "normally" sprayed plantation. The field work showed promising results.

Cutting the neighboring hardwoods down close enough to the ground to overcome the effect of resprouting guarantees needed sunlight and space to the selected fir trees. The cut brush helps retain moisture, discourages topsoil erosion, adds fertilizer, and reduces fire danger as it decays more quickly than sprayed brush. By contrast, sprayed hardwoods usually retain the dead, dried-out leaves for years. They shade the fir trees while increasing fire danger.

Unlike herbicide spraying, manual cutting can also combine with thinning, tree planting, and other forestry management operations to reduce administrative costs. It creates lots of jobs and increases wildlife habitat. If the chemical approach is effective in speeding up timber production, then manual techniques should really pay off.

Another separate study compared various approaches to brush control in the Descanso Ranger District of Southern California. The EAR published by the Forest Service concluded that GOATS (the four-legged variety) are "the most economical of all methods "to clear and maintain fire breaks in the chaparral brush."

What began as a search for alternatives to controversial herbicide use has evolved into a concern for the costs and benefits of the overall timber management prescription in which herbicides have played a part. A number of factors, such as the extensive "clearcutting" of an unstable rain forest, unchecked erosion, and late attempts at reforestation have contributed to declining productivity and beauty of our forests and rivers, while the demand for wood, fish, and recreation increases.

The subsequent lack of available "second growth" trees and the severely reduced salmon and steelhead runs are major reasons for the costly unemployment which plagues much of California's timber country. The use of helicopters to spray herbicides is an attempt to bridge the wood production gap, while further reducing employment opportunities and wildlife habitat.

GOATS will continue to work with any public or private organization interested in developing economically and biologically sound proposals aimed at increasing soil stabilization, reforestation, wildlife, recreation, and employment. Our resources include: The Handbook for Erosion Control in California Mountain Meadows and The Handbook for Erosion Control of California Mountain Roads, developed by the U.S. Forest Service as early as 1934 for use by the old Civilian Conservation Corps (CCC). The recently published, A Labor Intensive Approach to Watershed Repair, is another excellent recipe book for the job as we see it.

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Cost Analysis--Manual Conifer Release. Prepared by: Group for Organic Alternatives to Toxic Sprays (GOATS)

Introduction.

Since April 1977 G.O.A.T.S. volunteers have been periodically involved in field work exploring the practicality and applicability of manual conifer release in the Six Rivers National Forest, Lower Trinity Ranger District, Humboldt and Trinity Counties, California. First experience was gained through voluntary work performed under the direct field supervision of the U.S. Forest Service personnel. This work was performed on 10 acres of the Friday Ridge 10 Unit and on approximately 4 acres of the Baldwin B Block. On the basis of this work, the U.S. Forest Service prepared and put to public bid a contract for the manual release and conifer thinning of three reforested blocks in the Lower Trinity Ranger District. G.O.A.T.S. bid on and was awarded the contract for the 23-acre Salyer 4 and the 10-acre Hennessey 3 Units. A third block was deleted from the contract. Work commenced in October 1977 and was completed on February 27, 1978.

The Lower Trinity Ranger District has established a 5-year plan for manual conifer release. The Group for Organic Alternatives to Toxic Sprays is currently working with District personnel to establish work standards and specifications for these future public bid contracts.

The Method.

The specifications for manual conifer release were designed by the U.S. Forest Service--Silviculture in the Six Rivers National Forest.

Manual conifer release accomplishes three tasks: release, selection and spacing, and thinning.

1. Release: Each selected conifer is 100 percent released from all competing vegetation.

Technique: A 10-foot diameter circle is cleared around the conifer, cutting each stem below 10 inches.

Benefit: The conifer receives maximum sunlight immediately. Every branch receives full space to grow completely uninhibited. Therefore, conifers reach optimum width-growth--each additional needle increases photosynthesis for food which hastens the conifer's annual growth rate, maximizing its wood fiber (the total mass of the conifer).

Technique: All the cut brush is laid down horizontally, the main stem being as reasonably close as possible to the ground. The brush cannot be left leaning over on living vegetation, nor can it interfere with the branches of conifers above 12 inches.

Benefit: The brush composts most quickly on the ground--mulching the soil, it helps retain the moisture, and it may help inhibit the resprouting of some of the brush.

II. Selection and Spacing: Dominant conifers are selected, leaving ample space for each tree, similar to those grown in a controlled tree farm.

Technique: The dominant conifers are spaced approximately 8-10 feet apart, varying between 7-14 feet, according to the situation.

Benefit: Dominant conifers receive ideal space for optimum growth. Also, very importantly, if there aren't any conifers for 30 feet for instance (as is often the case), all the brush in between remains uncut. This is very good because it reduces the work/time and maintains the natural ecosystem for replenishing the soil, adding nutrients and bacteria which are beneficial for the health and growth of conifers.

III. Thinning: Thinning is a complete job in itself.

Technique: Every conifer which is not a selected conifer is cut down, even if less than 12 inches.

Benefit: This guarantees the proper stocking, releasing conifers from competition with themselves as well. Thinning is currently practiced in reforestation, even if the plot has been treated with herbicide. Manual conifer release, however, consumes this extra cost for thinning, both being inclusive under one contract.

Six Rivers National Forest--Specifications for Manual Conifer Release and Tree Thinning.

DIVISION 100--GENERAL SPECIFICATIONS

110--Scope of the Contract

Furnish all labor, tools, materials, equipment, transportation, and incidentals necessary to perform a conifer release and tree thinning by manual cutting within young plantations.

120--Location and Description

121--The project area(s) are located within the Six Rivers National Forest on the Lower Trinity Ranger District. The attached map(s) show specific unit locations. (Maps not included here.)

122--Access instructions, as shown, are for information only. It shall be the responsibility of the contractor to determine the most suitable route to the project area(s). The Government will not undertake any obligation for accomplishing special maintenance, such as plowing snow, to keep roads open.

123--Topography: The topography of the project area(s) varies from 10 percent to 80 percent slopes.

124--Density and Height: Stocking on the areas will vary from 175 to 650 conifer trees per acre and from 3 to 10 feet in height. Hardwood and brush varies from 6 feet to 30 feet in height.

125--Marked Boundaries: Project area boundaries have been marked with candy-striped flagging.

130--Pre-Work Conference

Prior to commencement of work, the Contracting Officer may require the contractor to meet with him, or his designated representative, to discuss work schedules and other matters concerning the contract. The Government will determine the time and place the meeting will be held.

140--Work Areas

The Government will specify a priority of work by units, or acres within the unit.

DIVISION 200--TECHNICAL SPECIFICATIONS

210--Definition of Terms

DBH--diameter of a tree at breast height, measured at a point 4-1/2 feet above ground on the uphill side of a tree.

AVERAGE SPACING--the average distance, in feet, between leave trees.

LEAVE TREES--any conifer tree that is selected by the contractor to be left standing as provided for in the specifications for leave tree selection.

SLASH--limbs and boles of trees, and any cut brush, resulting from the contractor's working operations.

220--Equipment

Contractor shall furnish power saws and/or other cutting equipment. The equipment shall be approved by the Government prior to its use, as to its suitability for this type of work and its compliance with fire hazard requirements.

230--Work Methods and Standards

To assist in obtaining maximum growth and yields on plantations, the contractor shall select conifer leave trees and release them from other conifers, hardwood trees, and other brush.

231--Leave Trees. The Government will, in a representative area, mark individual leave trees in small groups to illustrate proper leave tree selection. The contractor will select the leave trees for the remaining areas, complying with the following requirements:

A. Average Spacing

Approximate Spacing	Minimum Spacing	Range of Avg. # of Leave Trees Occupying a 1/50-Acre Plot		Range of Avg. # of Leave Trees/Acre	
10' X 10'	8' X 8'	Upper: 10	Lower: 8	Upper: 500	Lower: 400

B. Leave Tree Selection Priorities

1. Shall be conifers. Douglas-fir shall be favored over other conifers, all selection factors being equal.
2. Trees shall be free of visible insect and disease infactions or other severe damage.
3. The tallest trees having the largest percentage of live crown ration or a minimum of 40 percent live crown ratio.
4. Trees having the largest DBH.
5. Trees with less than 40 percent crown ratio and visible damage other than insect and disease may be left to meet the average spacing requirement.

232--Cutting Instructions and Removal of Slash

232.1--Cut all hardwoods, conifers, brush, and other vegetation within a 5-foot radius of the main stem of the crop tree. All cut stems shall be no more than 10 inches above ground level within the 5-foot radius.

232.2--All cuttings shall be cut completely free of the stump and the main stems shall be within 12 inches of the ground.

232.3--All cuttings shall be laid clearly of any limbs of the leave trees.

232.4--Contractor shall not cut any vegetation within 10 feet of a live or intermittent stream channel edge. Any cut slash which falls within this 10-foot strip shall be removed and placed inside the unit boundary. These areas will be designated on the ground.

232.5--Contractor shall remove any slash from cuttings which fall outside the boundary of the unit and place the slash inside the unit boundary.

232.6--Contractor shall remove all slash from the cuttings for a distance of 25 feet within the unit boundaries which are adjacent to any traveled road and place it inside the boundary of the unit.

232.7--Leave trees shall not be damaged in any way.

DIVISION 300--INSPECTION AND ACCEPTANCE

310--Unit Inspection Procedures

311--The Government shall inspect for compliance with specifications the units reported as complete by the contractor.

311.1--Each unit, as designed on the attached map(s) and listed in the schedule of bid items, shall be inspected as a separate unit and shall not be averaged with any other unit for acceptance or payment. (Maps not included here.)

311.2--The inspection shall be made on a series of 1/50-acre plots. Sufficient number of plots will be taken to total at least 1 percent of the area in the unit being inspected. Plots will be marked on the ground and recorded on unit map(s) for their approximate location.

312--The Government shall inspect the plot areas for the following items:

312.1--The total number of satisfactory trees that should have been left to meet the average spacing and trees per acre requirement.

312.2--Any deviation from the instructions regarding cutting and removal of slash.

313--The Government's inspection data and calculation report shall show the items listed below and the percentage of deduction for items not meeting the leave tree requirements.

1. Number of leave trees that should have been left.
2. Number of trees that were left.
3. Number of satisfactory leave trees.
4. Number of excess trees (uncut trees not needed to meet the average spacing requirements).
5. Number of trees deficient (cut trees that should have been left to maintain the average spacing and trees per acre requirements).

EXAMPLE:

Inspection Data and Calculation Report

Unit________________Sub-Unit_________

Column:	A	B	C	D	E	
Plot No.	No. of trees that should have been left	No. of trees left	No. of Satisfactory leave trees	Excess:5% for each tree (B-A)x5%	Deficient: 10% for each tree (A-C)x10%	Score: 100% = (D+E)
1	9	12	8	-15%	-10%	75%
2	9	9	9	-	-	100%
3	8	9	8	- 5%	-	95%
4	8	6	6	-	-20%	80%
5	9	9	9	-	-	100%

314--If any of the requirements on the cutting instructions and removal of slash are not fulfilled, that plot shall be considered unacceptable. The percentage shall be calculated by the number of unacceptable plots divided by the total number of plots taken.

Inspection Data and Calculation Report

Unit________________Sub-Unit_________

Plot No.	Acceptable	Unacceptable	Percentage of unacceptable plots ÷ No. of plots taken
1	✓		
2		✓	1
3	✓		
4	✓		
5	✓		

100 ÷ 5 = 20%

320--Determination of Unacceptable Work

321--If the percentage of acceptable work falls below 100 percent on the inspection for contractor compliance of satisfactory leave tree selection, the following shall apply:

321.1--A 5 percent error shall be allowed.

321.2--A payment deduction shall be made of the percentage falls below 95 percent but not lower than 90 percent.

321.3--When work falls below the 90 percent acceptable standard, payment shall not be made until contractor corrects the deficiencies and the results of a subsequent inspection show 90 percent, or more, acceptable work.

Table 1. (*See table 3 for cost breakdown.)

Hennessey Management Unit--10 acres

Release and thinning acres/days	.5	.75	1.0
Hours for completion/ acre	16	10.67	8
Total crew person cost/hour*	$12.68	$12.68	$12.68
Total cost/acre	$202.88	$135.28	$101.44

Hennessey 3--10 acres
Case History: Mixed conifer-hardwood forest; old growth Douglas-fir. Logged, 1959; site preparation, fall 1959; reforestation, manually planted in April 1960 (7 percent survival), natural seeding (23 percent survival), manual replanting in April 1963 (28 percent survival). Site Characteristics: Slope, 70-120 percent; dominant competing vegetation, Ceanothus intergerrimus, Ceanothus velutinus (var. laevigatus), Lithocarpus densiflora, Arbutus menziesii; crop conifer, Douglas-fir.

The center of the Hennessey Unit is badly eroded. Vegetation covers approximately 65 percent of the unit. The combination of steep slope, poor survival of vegetation, and heavy erosion have contributed to the low overall stocking of conifers observed on the Hennessey 3 Unit.

Table 2. (*See table 3 for cost breakdown.)

Salyer Management Unit--23 acres

Release and thinning acres/days	.3	.5	.75
Hours for completion/ acre	26-2/3	16	10.67
Total crew person cost/hour*	$12.68	$12.68	$12.68
Total cost/acre	$334.57	$202.88	$135.28

Salyer 4--23 acres
Case History: Mixed conifer-hardwood forest; old growth Douglas-fir. Clearcut logged, June 1968; site preparation, broadcast burn, October 1967; reforestation, manually planted in January 1978.
Site Characteristics: Slope, 0-60 percent; dominant competing vegetation, *Ceanothus intergerrimus*, *Ceanothus velutinus* (var. *Laevigatus*), *Lithocarpus densiflora*, *Arbutus menziesii*; crop conifer, Douglas-fir.
Distinct Vegetation Zones (approximate hardwood and brush densities): (1) dense *Ceanothus velutinus* (75 percent), interspersed *Lithocarpus densiflora* (20 percent), *Arbutus menziesii* (5 percent); (2) predominantly *Lithocarpus densiflora* (65 percent), *Ceanothus velutinus* (20 percent), *Arbutus menziesii* (10 percent), *Ceanothus intergerrimus* (5 percent); (3) predominantly *Ceanothus intergerrimus* (60 percent), *Lithocarpus densiflora* (30 percent), *Ceanothus velutinus* (7 percent), *Arbutus menziesii* (3 percent).

Interpretation of the Tables

What these tables can be used for is to help determine the different costs of the variety of type sites that are all combined in a contract block.

There are a variety of site characteristics (slope, conifer density, type of brush) which are all factors affecting the rate of work a person can produce in a certain area.

Age is the most important factor. Of the acres that comprise our field experience, all are of the older-age variety--12-18 years old. From this factor alone we can determine that our costs will be in the highest bracket--assuming that the younger sites (under 10 years old) cost considerably less time and money to complete.

The table is used as a scale--a range of costs based on a grouping of three work rates. The table is a range of combinations of site characteristics--in Salyer, for instance, some sites will be difficult and take one person 8 hours to complete 0.3 acre, others will be sparse and easy with a person completing 0.75 acre, but most often the areas between 12-18 years old should fall into the moderate Salyer range, completing 0.5 acre per 8-hour day.

In conclusion, the table allows for the two extremes out of the combinations of site types under one contract block.

Table 3

Itemized Crew Person Costs Per Hour

Wage (gross)		$7.10
Deductions to employee:		
FICA	5.85%	.42
FIT*	20.00%	1.45
SIT	2.00%	.14
SDI	1.00%	.07
Wage (net)		$5.02
Employer-paid benefits		
FICS	5.85%	.42
SUI	4.30%	.31
Workmans Compensation	19.80%	1.44
Health Insurance	$60/mo./man	.35
Retirement	3.00%	.22
Gross wages		$7.10
Total salary expenses		$9.84
Administrative expenses		
Liability Insurance		.30
Salary for non-crew		1.50
Tool cost and maintenance		.83
Transportation		.15
Other		.06

*Based on zero dependents.

Table 4

Inspection data and calculation report, duplicated from U.S.F.S. data derived from 11 1/50th-acre test plots to certify Hennessey Unit for completion and specification compliance. Also included is an unofficial set of plots, of which #1* was conducted in a portion of the Salyer Unit that was not yet thinned or released.

	Plot #	A. No. Trees that should have been left	B. No. of trees left	C. No. of satisfactory leave trees	D. Excess: 5% for each tree (B - A) X 5%	E. Deficient 10% for each tree (A - C) X 10%	Score 100% - (D + E)	Accepted
HENNESSEY	1	2	2	2	0	0	100%	Yes
	2	6	6	6	0	0	100%	Yes
	3	1	1	1	0	0	100%	Yes
	4	5	5	4	0	10%	90%	Yes
	5	7	8	7	5%	0%	95%	Yes
	6	4	5	4	5%	0	95%	Yes
	7	6	6	6	0	0	100%	Yes
	8	6	8	6	10%	0	90%	Yes
	9	8	8	8	0	0	100%	Yes
	10	5	5	5	0	0	100%	Yes
	11	2	2	2	0	0	100%	Yes
SALYER	1	4	8	4	20%	0	80%	No*
	2	7	9	7	10%	0	90%	Yes
	3	7	7	7	0	0	100%	Yes
	4	6	6	6	0	0	100%	Yes
	5	7	7	7	0	0	100%	Yes
	6	4	4	4	0	0	100%	Yes

Table 5

Chainsaw Cost Breakdown

1.	Purchase and depreciation	$0.27/hour
2.	Bar oil consumption	0.27/hour
3.	Gasoline costs	0.17/hour
4.	Shop labor	0.12/hour
	Total cost/hour for life of saw	$0.83/hour

1. Purchase and depreciation (based on usable saw life of 1280 hours)

$335.00	saw purchase
60.00	replacement parts
48.00	two chains
$443.00	subtotal
-100.00	resale return
$343.00	net cost for expected life of 1280 hours.

Cost/hour -- $343 divided by 1280 hours = $0.27/hour

2. Bar oil consumption

$2.80 1 gallon bar oil (saw uses 3/8-quart/hour)
3/8-quart/hour X $0.70/quart = $0.27/hour

Cost for bar oil = $0.27

3. Gasoline costs

$$1 \text{ gallon} = \underset{\text{gas}}{\$0.65} + \underset{\text{oil mix}}{(2/5)\ (\$0.60)}$$

1 gallon = $0.89 (saw uses 3/4 quart/hour)

Gasoline costs = $0.17

4. Shop labor

10 hours @ $15/hour = $150.00

$150/1280*= $0.12/hour (*hours of saw life)

Chainsaw breakdown was provided by Mr. Randal Oliver.

His experience in the field consists of 3 years of chainsaw work. This work included doing a 40-acre conifer release job for wages, a 60-acre post-harvest slash cutting job by contract, and cutting some 20 to 30 cords of firewood for sale.

Mr. Oliver has had 1 year of business experience managing a retail farm store. He is currently a graduate student in Fisheries at Humboldt State University, Arcata, California.

All chainsaw costs were based on a Model 031 Stihl chainsaw (GOATS personnel are presently using three Stihl chainsaws in the field).

Release of Crop Conifers

Conifer release is a forestry management technique. It is based on the assumption that the growth of desired crop conifers can be increased if the growth of undesirable competing vegetation can be inhibited. Aerially applied phenoxy herbicides have typically been used for this procedure. However, in February 1977, when widespread complaints of "mishaps" followed helicopter spraying in forested areas, GOATS began to research alternatives.

No matter which method of release is chosen, conifers appear to respond best to release treatment 5 to 10 years after restocking. The young conifer seedlings generally benefit from the shade and close proximity of neighboring plants for their first 3 to 5 years of growth. After they have become established, however, maximum sunlight and moisture to the growing seedling seems essential for their fastest growth. At this stage, if the growth of competing vegetation can be selectively inhibited, it is believed that the conifer has an excellent chance of maximum growth and release.

The competing plants (ceanothus, tan oak, madrone, manzanita, and other brush species) move into newly clearcut sites soon after logging. Once established, they can grow up to 10 feet tall within 15 years.

The Group for Organic Alternatives to Toxic Sprays has manually released 47 acres (sites 12 to 18 years old) of the Six Rivers National Forest, Lower Trinity Ranger District. Based on this field experience, manual conifer release should be initiated before competing brush becomes too dominant. If used as a release procedure on older sites, the expected cost would be greater than a manual release operation performed on the same site between 5 to 10 years after restocking.

Figure 1--Annual average of persons working in timber industry from 1955-1975 for Humboldt, Mendocino, and Del Norte Counties

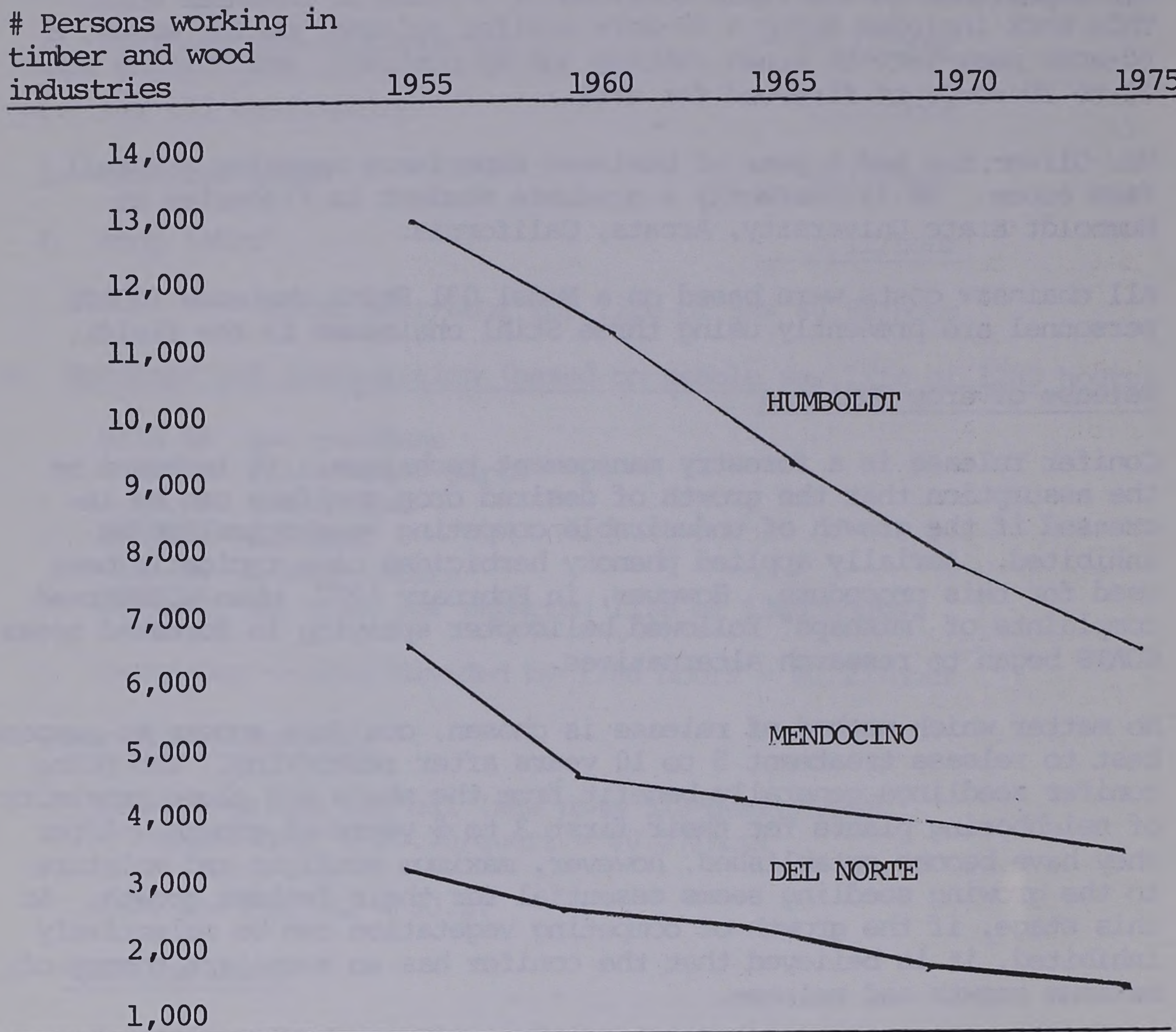

Figure 2--Use levels of phenoxyacetic acid herbicides in Humboldt County 1970-1976[1]

Year	Acres treated
1970	331
1971	445
1972	1,704
1973	3,348
1974	6,118
1975	11,867
1976	8,888
TOTAL	32,711

[1]Data supplied by Humboldt County Agriculture Department.

SUBMISSION BY SOUTH OKANAGAN ENVIRONMENTAL COALITION

Information Release--January 26, 1978

Since the release of our study, "The Other Face of 2,4-D--A Citizens' Report," we have received many requests for copies. The study is in fact an offset printed book with 147 pages of text, photos, tables and diagrams, and a 19-page bibliography. The Contents include: Teratogenic (Birth Defects) Effects of 2,4-D; Cancer and the Phenoxy Herbicides; Is 2,4-D a Mutagen?; Dioxins in Phenoxy Herbicides; Acute and Subacute Illness Caused by Phenoxy Herbicides; Environmental Effects of 2,4-D (Wildlife and Agriculture); Persistence of 2,4-D in the Environment. While the report concentrates on 2,4-D, it also discusses the other phenoxy herbicides 2,4,5-T and 2,4,5-TP (fenoprop, silvex). The report is written with standard scientific methods. All material is documented by sources which are fully presented in the bibliography. The text is written for the layperson with all terms clearly explained. We hope this book will provide the basis for citizen education programs in areas where these chemicals are misused.

Because our organization is underfinanced (as usual) and the printing costs alone for the 500-book first edition were $3,000, we must sell "The Other Face of 2,4-D" for $7.00, postage included. If you can furnish us with a documented case study of damage done to humans, domestic animals, wildlife, fish, or crops, we will send the book to you at $5.50. We are planning to produce a four-page newspaper format condensed version of our study which we will be able to provide at a nominal cost. We have not set a completion date for that project at this time.

You can receive "The Other Face of 2,4-D" postpaid by sending $7.00 to the address below. The book will be shipped immediately. If you would like the condensed version, let us know, and we will contact you when it is ready. Thanks for your interest. (Jay Lewis, Information Director, Box 188, Penticton, B.C. V2A 6K3.)

SUBMISSION BY JAMES H. B. DE GRUCHY

Following is an October 1, 1975, letter with attachments that was written by Dr. de Gruchy to Senator Jim E. Lane.

Senator Jim E. Lane, Chairman
Members, Special Committee on State Forestry Laws
Oklahoma State Capitol Building
Oklahoma City, Oklahoma

Dear Senator Lane and Committee Members:

In compliance with a request from Chairman Senator Lane, I am herewith presenting a written report on my oral presentation at your meeting September 8, 1975. The material enclosed, I believe, will be helpful to you in arriving at a law that will preserve the integrity of the people, the land, and the futurity of Oklahoma. Time, at the meeting, did not permit a full presentation of my prepared talk, but I believe that from the additional papers and comments you will be able to put together the important facts.

A short summary of the enclosed topics and my own recommendations are presented for your consideration.

(1) The poisonous nature of the chemicals 2,4-D and 2,4,5-T and the chemicals produced concurrently with 2,4-D and 2,4,5-T, alone, are sufficient to ban its use everywhere in the U.S. for any purpose.

The free radicals: Super oxide anion (O_2^-), hydrogen peroxide (H_2O_2), and the activated hydroxal radical ($OH^\bullet$), have the ability to form arene oxides from the aromatic chemicals concurrent with the manufacture and the degradation products of the above mentioned herbicides and others. These arene oxides are capable of uniting covalently with protein, DNA, RNA, and other molecules of the cell, forming stable molecules that can permanently change life's vital energy processes, producing impaired growth, fetal deformities, mutations, and cancer. This is another potent reason why all pesticides containing aromatic ring compounds should be prohibited. See Topic No. 1, 2,4-D, 2,4,5-T TOXICITY AND GENETIC DAMAGE.

(2) In the catalytic process of the cracking of petroleum, carcinogenic compounds as well as aromatic compounds, capable of forming the highly toxic arene oxides, are formed. It is almost impossible to remove these toxic compounds from diesel oil and for that reason the use of diesel oils as a carrier for pesticides for spraying should be prohibited. See Topic No. 2, POLYCYCLIC HYDROCARBONS.

(3) Mayo Clinic's report on three cases of neuropathy and edema caused by exposure to 2,4-D definitely established its toxicity. Dr. Verrett's statement, page 10, Report to the State Committee on Commerce, April 10, 1970, states that the reaction caused by 2,4-D is similar to 2,4,5-T, which makes them both fetal deforming down to 1 ppm. Copies of both are in your files. See Topic No. 3, PERIPHERAL NEUROPATHY, 2,4-D--MAYO CLINIC.

(4) Some of the slides shown to the Commission showed actual plant and animal damage now existing in the Kiamichi Country as a result of the spraying of 2,4-D and 2,4,5-T. See Topic No. 4, PLANT AND ANIMAL RESPONSES TO 2,4-D and 2,4,5-T.

(5) The complete destruction of timber and vegetation by burning as you saw in the slide does two things: 1. The burning releases into the atmosphere many simple aromatic and polycyclic aromatic hydrocarbons, capable of uniting with heat-activated atmospheric oxygen to produce the deadly arene oxides. 2. The hundred of tons of burning timber contained proteins, carbohydrates, trace elements, and minerals that need to be returned to the soil to be used by a new generation of plants. The process of decay is a must if the fertility of the land and the health of plants, animals, and people are to be sustained. All burning processes should be stopped immediately on all timber lands and waste vegetation must remain on the land. See Topic No. 5, BURNING, CLEARCUTTING, AND EROSION.

(6) Nitrates and nitrites can create a problem if the runoff causes a heavy concentration in our drinking waters. Nitrates convert to nitrites, and nitrites to nitrosoamines which are known cancer producers. See Topic No. 6, THE NITRITE PROBLEMS.

(7) The conclusion points out the reason why we need to avoid contaminating the environment with any agent capable of interfering with life's normal processes. See Topic 7, CONCLUSION.

(8) A list of Congressional Record references.

Sincerely,

JAMES H. B. de GRUCHY, Ph.D
Route #1, Kiowa, Oklahoma 74553

<u>TOPIC NO. 1. 2,4-D, 2,4,5-T TOXICITY AND GENETIC DAMAGE</u>--The cyclic aromatic compounds, toluene, phenol, and dichlorophenol, formed from benzene in the manufacture of 2,4-D and 2,4,5-T are not only toxic but are cancer producers. Through their reaction with the highly activated molecules of oxygen, superoxide anion ($O_2^{\bar{\cdot}}$), hydrogen peroxide (H_2O_2), and the activated hydroxyl radical ($OH^{\cdot}$), they form arene oxides which in turn are capable of binding covalently with protein molecules, DNA molecules, and the RNA molecules, forming a stable combination capable of interfering permanently with the genetic coding inherent in the cell, causing a change in the life processes. Depending on the place of its binding and the nature of the molecule to which it is bound determines whether it becomes a toxin, a mutation producer, a fetal deformer, a cancer producer, or just a piece of rubbish floating around in the living cell.

The great danger to all aerobic life comes when the number of oxygen-free radicals mentioned above become greater than the natural defenses against them. The enzymes superoxide dismutase and catylase can make them harmless. The arene oxides formed outside the cell can move through a partially ruptured membrane or can be carried through by a surfactant. Thus we can see the importance of eliminating from our

environment at every possible turn the aromatic compounds capable of forming arene oxides. The compound tetra chlorodibenzo-para-dioxin, the second most toxic substance known, is an arene oxide and is found in the commercial products 2,4-D and 2,4,5-T. This is the most important reason why 2,4-D, 2,4,5-T, and other related aromatic organic ring compound pesticides should be completely banned.

<u>Free Radical Inhibitory Effect of Some Anticancer Compounds</u>. K. K. Georgieff, page 537, Science, 3 August 1971.

<u>Arene Oxides: Biochemistry and Metabolism</u>. Sidney Udenfriend and Paul Bartl, page 779, Science, 17 November 1972.

<u>Arene Oxides: A New Aspect of Drug Metabolism</u>. D. M. Jerina and J. W. Daly, page 573, Science, 16 August 1974.

<u>Epoxides of Carcinogenic Polycyclic Hydrocarbons are Frameshift Mutagens</u>. Bruce N. Ames and P. L. Grover, page 47, Science, 7 April 1972.

<u>Chemical Carcinogensis. A Long Neglected Field Blossoms</u>. Thomas H. Maugh II, page 940, Science, 8 March 1974.

<u>6-Hydroxydopamine: Evidence for Superoxide Radical as an Oxidative Intermediate</u>. Richard E. Heikkila and Gerald Cohen, page 457, Science, 3 August 1973.

<u>TOPIC NO. 2. POLYCYCLIC HYDROCARBONS</u>--The polychlorinated biphenyls are relatively inert compounds, some 50 or more theoretically are possible by chlorinating biphenyls. It is possible also that the dichlorophenols produced in the degrading process of 2,4-D and 2,4,5-T can be changed into polychlorinated biphenyls. The polychlorinated biphenyls have been found to be toxic to fish and shrimp down to a few parts per billion.

<u>Chemical Pollution: Polychlorinated Biphenyls</u>. Page 56, third column, Science, 14 January 1972.

Added to this group can be the polycyclic aromatic hydrocarbons produced in the catalytic cracking of petroleum in the production of diesel fuels. Diesel fuels are used by nearly all aerial sprayers to carry the herbicides in their drops to the foliage of the plants. It is rather hard to believe that our diesel manufacturers would spend the money to remove the carcinogenic high molecular compounds from their diesel fuels. The cost would be prohibitive and would be out of reach for the consumer. The use of diesel fuels should be prohibited as a vehicular medium for all pesticides.

<u>High Molecular Compounds in Petroleum</u>. S. R. Serginko, page 230, Israel Program for Scientific Translations. Jerusalem.

TOPIC NO. 3. PERIPHERAL NEUROPATHY--2,4,-D, MAYO CLINIC--The three cases of peripheral neuropathy after exposure to an ester of 2,4-D should leave no doubt as to the neural toxicity of the herbicide. How the herbicide causes the sensory loss, the loss of the control of muscular movement, and edema is not known; however, we do know that in the case of a nerve cell, a wave of electronegativity travels through the nerve's lipoprotein membrane. As the wave passes through the membrane, the ratio of the sodium and potassium ions that exists between those on the outside and those that exist on the inside changes. Before another wave of electronegativity can be sent through the membrane, the ratio of the potassium ions and the sodium ions between the two sides of the membrane must be brought back to their original ratio. We also know that 2,4-D and the substances concurrent with their manufacture and degradation have the ability to corrode the lipoprotein membrane. This could change the ratios existing between the working ratios of the sodium and potassium ions across the membrane, thus causing a change in the speed of the wave of electronegativity or cause its complete loss.

The corrosive effect of the herbicide on the muscle and the other cells could be the cause of the edema (swelling) of the leg and arms of the victim.

Peripheral Neuropathy, 2,4-D. Goldstein et al, page 134, Journal American Society, 7 November 1950.

TOPIC NO. 4. PLANT AND ANIMAL RESPONSES TO 2,4-D and 2,4,5-T PERSISTENCE--The slides shown to the Special Committee on State Forestry Laws, September 8, 1975, were to demonstrate the destructive action of 2,4-D and 2,4,5-T on plants and animals. The slide of the giant ragweed tip showed meristematic bud tissue damage and possible corrosive action on cell membranes with blockage of the plants transportation system. The slides of the giant lettuce plants showed the change from the normal differentiation of the cells of the apical meristematic tissue to an abnormal differentiation of the cells that resulted in the production of a plant monstrosity. This change in differentiation can be accounted for only by a change in genetic coding. To accomplish this feat, the herbicide or its metabolite had to gain entrance to the cell and covalently bind to the genetic material. Deformities in animals are produced in the same way. The difference in size of the pigs shown in the slide and the deaths at birth of five pigs can be accounted for by the herbicide or its metabolite crossing the placental barrier and then interfering with the energy changes of nourishment to the extent that the cells were underdeveloped and unable to maintain life at birth. One of the pigs developed to an abnormal size. These fetal abnormalities might be easy to blame on some disease; bu when you find that on this farm nothing like this had ever happened before and that this same farm had suffered a drift of herbicide destroying all of the lespedeza down to the root stock, killed the bois d'arc trees, fruit trees, and many others, you have reason to believe that this fetal deformity was

caused by the herbicide. What makes this more convincing is that in this same farm's small herd, 25 cows failed to conceive or, if they did, their fetuses were resorbed. Out of the cows that did conceive, 13 of the calves died before they were 1 month old. Four of these calves were dead at birth.

The blackberry and lespedeza slides demonstrated that the poisons continued to exist in the soil and the plants 6 years after a wind drift of the herbicide hit the area. These plants showed abnormal differentiation of the meristematic cells of the plants.

TOPIC NO. 5. CLEARCUTTING, BURNING, AND EROSION--Conservation practices by top agriculturists and foresters have long advocated that vegetation of any kind should not be destroyed by fire. Nature, through many seasons of growth and decay of vegetation, built the soil to the fertility state that supports the timber or vegetation. To allow someone to come in and exploit this natural heritage of soil and timber is not in the best public interest, present or future. The public interest must be protected through Oklahoma State laws which take into consideration the facts put forth in the following enclosed papers. These papers may seem a bit long to the reader but are necessary to understand the reason for placing limits and controls on any individual or company removing timber from our forest land.

The following statements are presented for your consideration:

The stand of timber mentioned above represents a supply of energy that is going to be sorely needed with the present and future shortages of energy that are sure to come.

The hardwoods and so-called "junk woods" by the present day foresters are needed to produce useful chemical products: phenols, phenolic resins, polyesters, and other useful aromatics: cellulose, glucose, ethanol, butadiene or ethylene, and many other by-products. I am attaching a copy of "Potential for Converting Wood into Plastics" by Irvin S. Goldstein, Science, page 847, 12 September 1975 (not included in material submitted for this publication). The economics and extent of the use of these hardwoods is well explained in this article.

The branches, bark, and unused portions of felled trees are needed for cover to prevent erosion and in decay supply the soil with the most valuable fertilizer the soil can use and must be returned to the land on which it developed.

Under no circumstances should all of the timber be removed from the land. Clearcutting of vegetation and burning of any timber or vegetation should be stopped immediately. Strict monitoring of this rule should be maintained and violaters prohibited from operating in the State.

Clearcutting for nurseries should be allowed only on lands with slopes less than 4 percent and then only if all of the timber that is removed is made into useful products. Any timber and branches not used should be shredded and worked into the nursery soil. Nursery plots should be small--40 acres or less with greenbelts for animal refuge in every square mile.

Some foresters and agriculturists think that the loss of soil on places up to 12 percent slope of the land and greater, laid bare by heavy machinery and turned-up soil is minimal, since it will not be broken again for a period of 15 to 25 years [sic]. In order to really understand the loss through soil erosion, one has to see sloped virgin timber or grass land planted to cotton go from a production of over one bale to less than one-quarter bale to the acre in less than 10 years.

In the first 3 years of reforestation it is reasonable to expect that one-quarter inch, possibly up to 1 inch, of the finest top soil will be eroded. The amount of erosion will increase with each 25-year planting procedure, and anyone can estimate the loss in a century's time. After 150 years or less the young planted forests will gradually decrease in production, and the companies will pull out. This happened in Oregon; why should we think that it won't happen again here in Oklahoma? The first, and possibly the second, crop of trees will furnish bountiful yield, but it will be at the long-range expense of the land and the people of Oklahoma.

Whenever a marketable tree is removed from the forest floor, one or two young nursery trees, or more, if space permits, should be planted in its place. Only enough ground space around the tree should be broken to give the tree a start in life.

The production of plastics from wood is a highly technical process that calls for close technical know how and knowledgeable supervision. A close monitoring and control must be put on all activities to assure that all by-products poisonous to man are not released into the atmosphere or down stream.

The destruction of timber, soil, and wildlife and needless injury to man have no place in the futurity of Oklahoma. No private industry, the State, nor the individual should have the right to ignore the rights of the public for unnecessary gains. We must follow the rules we have learned from observing nature if we expect to maintain a place suitable for future generations.

TOPIC NO. 6. THE NITRITE PROBLEMS--The use of nitrates as fertilizer presents a danger not so much in the soil, because there are many bacterial in the soil continually changing nitrates to nitrites and others that change nitrites to nitrates, but the danger is greatest when excessive amounts of nitrates or nitrites are washed into drinking

water. However, if either the nitrates or the nitrites are taken into the body through water or food (especially the nitrites), nitroso-amines are formed. Nitrosoamines have been proven to be cancerous.

Environmental Nitroso Compound: Reaction with Creatine and Creatinine. Page 1341, Science, 24 December 1971.

Selective Toxicity. Adrian Albert, page 377, Newspaper Clipping, E.P.A. Probes Possible Cancer Threat, Tulsa Daily World, September 20, 1975.

TOPIC NO. 7. CONCLUSION--The International Union Against Cancer twice passed a resolution establishing zero tolerance for any substance that could induce cancer in any species of animal by any route of administration. Below are excerpts taken from page 344, Chemical Induction of Cancer, Arcos, et al., 1968.

"There is some evidence that carcinogenic substances show cumulative effects. This means that the carcinogenic effect persists for a long period even after elimination of the active agent by metabolism, and so even minute doses may prove to be carcinogenic if their administration is repeated for a sufficiently long time, because the carcinogenic action of all single doses is additive. If we accept the validity of these findings, then the conclusion must be that no threshold dose or safe dose for carcinogenic substance may be set, the more so as there may be a summation of different carcinogenic influences present in the human environment."

"No matter how high or how low the 'safe' subthreshold dose of a carcinogen is set, however, the inescapable fact must be faced that unlike in animal assays where experimental conditions are rigidly set and controlled, in the human environment there are a great number of various carcinogenic influences which are mutually antagonistic at best and synergistic at worst. Therefore, even if the true subthreshold level is demonstrated for some carcinogens under laboratory conditions, extrapolation of the significance of such findings to human living in the normal human environment is not meaningful. The multiplicity of environmental carcinogens is furthermore compounded by the possibility that for some types of agents, at least, even very small carcinogenic effects are cumulative. The latter possibility has considerable ramifications in the establishment of correct legal standards for protection against industrial hazards and for the realistic appraisal of insurance risks. An analysis, based on statistical considerations, of the concept of threshold dose made by Mangel and Bryan concluded that the carcinogenic hazard never disappears but gradually becomes smaller with diminishing dose."

A review of the statistics can give us an idea of the extent of the pesticide problem. It is estimated that 1.2 billion pounds of synthetic organic pesticides were used in the United States in 1973; and with an expected increase of 17 percent yearly, it is reasonable to believe

that thousands of people, even you and I, are carrying around in our or their bodies living cells in which a cancer has already been initiated by the arene oxides produced from the synthetic organic compounds in these pesticides. It is quite possible that these cancer-initiated cells have only to receive one or more initiating, or cancer promoting molecules, to cause them to bloom into a full-blown metastasis that once started cannot be stopped without complete removal. It is reasonable to believe that many of the more than 350,000 people who die in the United States every year because through the years the summation of cancer initiations from pesticides and other agencies were the cause of that deadly metastasis. "If present trends are allowed to continue, by the year 2000 A.D. we will have 1.2 million cases of cancer each year with about 500,000 deaths in the United States alone." (Dr. Frank J. Rausher, Director National Cancer Institute)

In addition to the cancer problem mentioned above is the frightening fact that next year one out of every four children born will be fetally deformed. The care of these individuals represents an enormous economic burden to society as well as the sorrow brought to the families. We gladly put our dollars and hearts into helping these individuals, but we need to work just as fervently preventing future deformities. By eliminating the aromatic hydrocarbons capable of producing arene oxides which help to cause fetal deformities, we could be well on our way to this accomplishment.

TOPIC NO. 8. CONGRESSIONAL RECORD OF REFERENCES, Amendment S 1782--
Reference to statements in Senator Nelson's proposed amendment S 1782 to the Interior Appropriations bill which would prohibit the use of herbicide 2,4,5-T on any lands within the Un ited States National Forest System. Congressional Record, August 7, 1974, page S 14509.

1.	Extreme toxicity of TCDD	par. 4, col. 3, S 14509
2.	Tendency to misunderstand	par. 3, col. 3 S 14509
3.	Birth defects TCDD	par. 4, col. 3, S 14509
4.	Scientific safety tests	par. 3, col. 1, S 14510
5.	Polychlorophenol to dioxin, env. cond. heat [sic]	par. 3, col. 2, S 14510
6.	Residues of TCDD, persistence-biocumulative	par. 6, col. 2, S 14510
7.	Storing--body tissues of cattle--TCDD	par. 7, col. 2, S 14510
8.	Distances traveled by drift-water transport	par. 1, col. 3, S 14510
9.	Post-natal survival--pigs and cattle	par. 2, col. 3, S 14512
10.	Intestinal hemorrhage--fetal abortion	par. 3, col. 3, S 14512
11.	Knowledge and birth defects	par. 4, col. 3, S 14512
12.	Society's part--recognition by observation	par. 5, col. 3, S 14512

13.	Physiological variations--animals and man	par. 2, col. 1, S 14513
14.	No-effect levels--TCDD	par. 5, col. 1, S 14513
15.	Birth defects--humans	par. 1, col. 2, S 14513
16.	Adverse post-natal defects	par. 3, col. 1, S 14513
17.	Registrants and body counts	par. 6, col. 1. S 14514
18.	Conversion to lethal dioxin	par. 7, col. 2, S 14514
19.	TCDD--burning at parts less than 0.05 ppm	par. 5, col. 2, S 14514
20.	Storage in fish--metabolites	par. 8, col. 3, S 14514
21.	Metabolites of 2,4-D	par. 1-5, col. 1, S 14515
22.	Tetra-dioxin bicumulative	par. 1, col. 2, S 14515
23.	TCDD--comparison soil and water	par. 4&5, col. 2, S 14515
24.	1 ppm TCDD and accumulative levels	par. 6&7, col. 2, S 14515
25.	Residues in shrimp and crustacea--Vietnam	par. 2, col. 3, S 14515
26.	Beef calves and 25 percent retention of TCDD	par. 4, col. 3, S 14515
27.	Cattle, sheep, and goats--0.04 ppm to 10.08 ppt	par. 6, col. 3, S 14515
28.	Wildlife up to 397 ppt--shrews average 202 ppt	par. 7, col. 3, S 14515
29.	2,4,5-T related TCDD persistence and bioconcentrates	par. 8, col. 3, S 14515

COMMENTS SUBMITTED BY MARILYN DE CORTE

In the Shenandoah National Park, Virginia, there is a Swamp Nature Trail, a second-growth forest; the original dense forest was stripped and robbed of its fertility and wildlife. Under National Park protection, nature has healed many of the manmade scars.

Your Swamp Nature Trail Guide Book (published in cooperation with the Shenandoah National Park, National Park Service, U.S. Department of the Interior) tells about nature's soil factory, ". . . on these rocks grow several species of lichen (pronounced (pronounced li-ken). Their rootlike organs produce an acid which slowly dissolves tiny holes in the solid rock. Water seeps into these openings and, in winter, frost action helps break the rocks into a coarse send. Mosses, ferns, and other plans may then start growing. These die and decay to form humus. By this process nature manufactures obout 1 inch of topsoil from solid rock every 500 years. No wonder we hear so much about the importance of soil conservation!"

Then we are lead to another station on the Nature Trail. We read, "At this station a tree that fell long ago is being recycled into soil. Decomposing elements, including boring insects, fungi, and bacteria decompose the wood that is eventually absorbed into the soil. Renewed with nutrients, the enriched soil supports a variety of young plants. Processes of growth, reproduction, and death provide a cycle of continuous change. All plants and animals, whether living or dead, are essential to the survival of a healthy forest community."

Why then the use of herbicides, such as 2,4,5-T, which disrupts "nature's soil factory" as stated above and purported by our Trail Guide Book? Why then the use of these herbicides such as 2,4,5-T when the cyclic aromatic compounds, touluene, phenol, and dichlorophenol formed from benzene in the manufacture of 2,4-D and 2,4,5-T are not only toxic but carcinogenic?